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## Scientific Studies in the Coastal and Estuarine Areas of Everglades National Park: An Annotated Bibliography

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# SCIENTIFIC STUDIES IN THE COASTAL AND ESTUARINE AREAS OF EVERGLADES NATIONAL PARK: AN ANNOTATED BIBLIOGRAPHY

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ABSTRACT

A total of 493 references (published and unpublished) on scientific studies in the coastal and estuarine areas of Everglades National Park (ENP) were annotated and subsequently indexed and arranged according to major scientific topics including zoology, geology, botany, hydrometeorology, water quality, and pollution. The geographic focus was three major estuaries located within the boundaries of ENP. Studies from a wider area were included if they also sampled in park estuaries. This report was developed to provide researchers and resource managers with access to the rapidly accumulating body of information on the park's marine resources. It may be considered current through December 1989. Many references listed were completed during the last decade.

## INTRODUCTION

Numerous scientific studies have been conducted in the coastal and estuarine areas of Everglades National Park. These data exist in a variety of formats. Data sets may contain physical and chemical parameters (e.g., water chemistry, meteorological conditions, etc.), descriptions of natural systems (e.g., seagrass beds, mangroves, etc.), and population data (e.g. abundance, distribution, and life history characteristics for ichthyoplankton, etc.). Also, descriptors of community dynamics (e.g., trophic relationships, nutrient cycles, etc.), organism response to changing environmental conditions and data reflecting other complex relationships were routinely collected. These data sets may range from limited (e.g., observations of species abundance over a specified time period) to large (e.g., a data set containing hydrological parameters collected every minute for an indefinite period of time). Ecological spatial scale may also exhibit tremendous variation in the form of microhabitats on mangrove roots to the region-wide environments of the coastal mangrove zone. Although these data sets serve as a valuable resource for long-term planning management

of the park 's marine resources, it was found, in many cases, that most of the research results were not centrally located, or organized in a way to make it easily accessible for computerization or for documentation of pertinent information concerning station locations, types of sampling gear used, and all parameters measured. Although published information could easily be obtained through library searches, much of the scientific studies were in the form of technical/final reports, proceedings of conferences, and unpublished theses and dissertations and are often difficult to obtain. As a result, a reasonable compilation of many of the scientific studies conducted on the park 's marine resources has not been available. The primary objective of this report is to provide researchers and resource managers with a readily accessible document on the rapidly accumulating body of information on the park's marine resources. Also, this compilation may serve as an important source of biological and ecological information needed to document the existence, identity, characteristics, numbers, location, and distribution of estuarine and marine species for inclusion in the park's Natural Heritage Program.

The present bibliographic guide to marine research in ENP contains 493 references and covers the period 1894-1989 (Table 1). All available literature on the park's marine resources were included through 1989. Some 1990 papers are included; although, it is by no means a complete listing. Arrangement is alphabetical by senior author and title. Entries are numbered in sequence and each includes a complete bibliographic citation with abstract or summary including specific information footnoted with each abstract when available. Authors' abstracts were not footnoted. While some attempt has been made to achieve uniformity in style, in many cases the terminology, spelling, capitalization, and phraseology of the original author or abstractor has been retained. Late additions appear at the end of the bibliography and are numbered beginning with "500". Due to the practical needs of researchers and managers and the volume of the materials cited, the entries were indexed by broad fields of study, specialty sub-headings, geographical area

of study, and by both senior and joint authors. Each citation is listed under as many headings as is appropiate for the cited article. For each citation there are, on average, three entries in the subject index. This cross-indexing system was constructed under the support of a bibliographic database system.

Table 1. Number of citations by date.

| YEARS | NUMBER OF CITATIONS | YEARS | NUMBER OF CITATIONS |
|---|---|---|---|
| 1890-1899 | 1 | 1950-1959 | 24 |
| 1900-1909 | 0 | 1960-1969 | 125 |
| 1910-1919 | 1 | 1970-1979 | 137 |
| 1920-1929 | 1 | 1980-1989 | 190 |
| 1930-1939 | 0 | 1990+- | 7 |
| 1940-1949 | 7 | | |

*Geographic Limitation*

The geographic boundaries established for the park's major estuaries (Florida Bay, Big Cypress, and Everglades) are as in Schmidt and Davis (1978, no. 354 in bibliography). To briefly summarize, the Big Cypress estuary is located between West Pass-Chokoloskee Bay and the Broad River; the Everglades estuary is located between the Harney River and Whitewater Bay to the southern end of the Buttonwood Canal, while Florida Bay includes the Cape Sable-Lake Ingrahm region and the waters and keys from the mangrove-lined bays and sounds along the northern Florida Bay shoreline to the extreme southern tip of the park boundary near Long Key (Fig. 1). The geographic index is to studies that were done either completely within, or partially within, the strict confines of the national park boundary. A few studies were undertaken adjacent to, or on the park boundary itself and were also included. All estuaries, bays, and rivers within ENP were included, as well as both intertidal and subtidal environments.

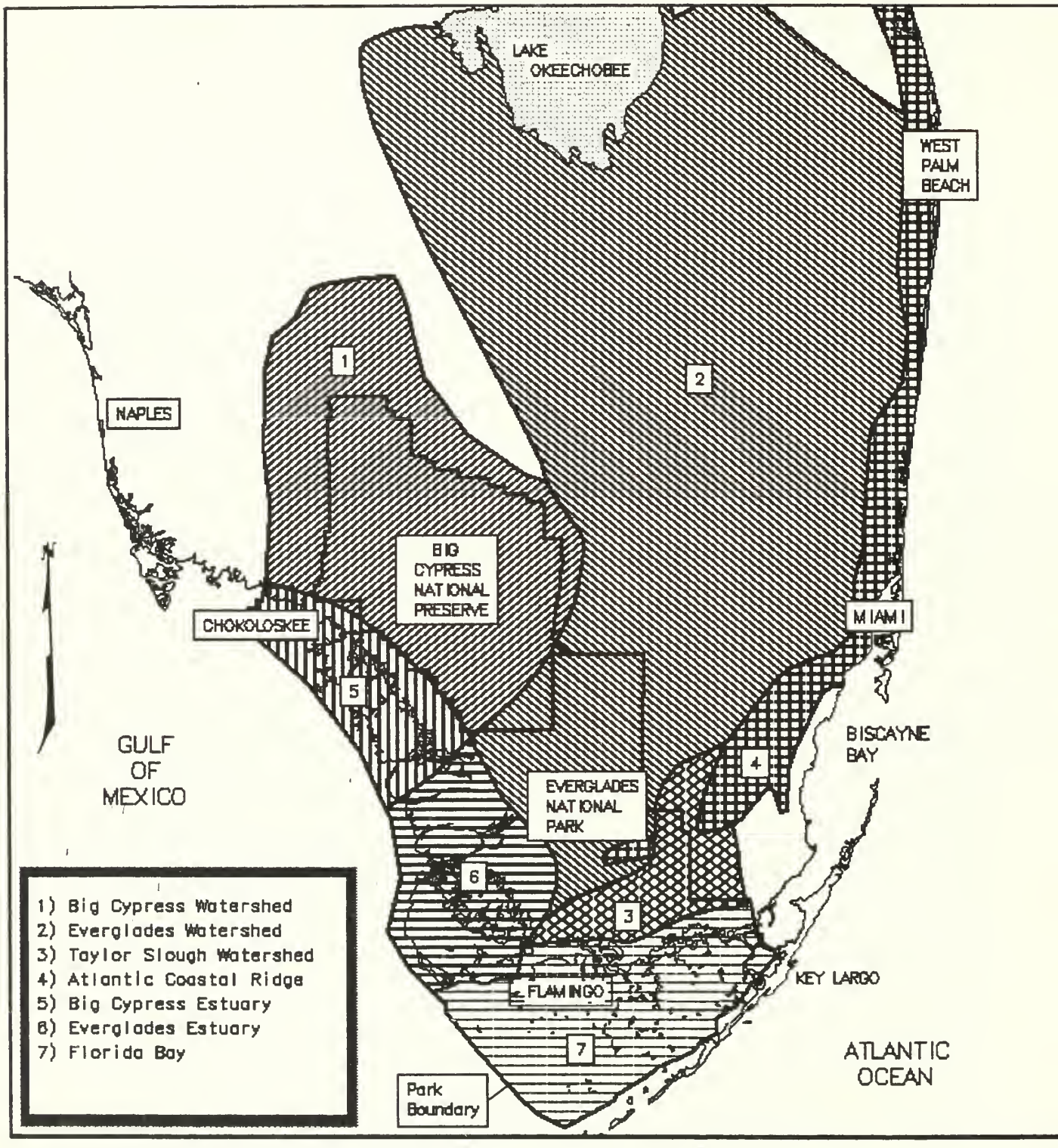


Figure 1. Map of southern Florida showing major water sheds and coastal zones in Everglades National Park.

The subject matter of the annotated bibliography is the scientific studies conducted in the coastal and estuarine areas of ENP. A broad range of marine topics were found under this heading including botany, zoology, ecology, water quality, hydrometeorology, pollution and geology. The major topics were sub-divided into those specialty areas that are shared most often among the studies examined. For example, water quality was sub-divided into salinity and temperature each of which represent those water quality parameters measured most often. The inclusion or exclusion of a given reference within a major topic area or specialty sub-heading was, at least, in part, a subjective decision. The most important major topics of study, based on the frequency of the assembled references, was zoology, followed by geology, water quality, and botany (Table 2). Within the subheading, sport and commercial fisheries, pink shrimp was by far the most frequently cited species of study. Park bays and estuaries have been studied extensively for their importance as nursery grounds for juvenile pink shrimp. Spotted seatrout and gray snapper, among the most popular sportfish in ENP, were ranked nearly equally in importance for citations behind pink shrimp. Most of the studies listed (82%), were sampled within the Florida Bay portion of ENP (Table 2). The least studied major estuary was the Big Cypress, due, in part, to its remoteness from developed areas.

No attempt has been made to incorporate references on coastal birds in this report. Many of the large number of articles available on coastal birds in ENP are located in popular magazines such as Audubon (W.B. Robertson, Jr, pers. comm.).

Table 2. Number of citations by major subjects and specialty areas. (Each reference could be placed in several appropriate categories. Major subjects are underlined.)

| SUBJECT | NUMBER OF CITATIONS |
|---|---|
| BOTANY | 97 |
| General Review/Bibliography | 11 |
| Algae (including diatoms/dinoflagelletes/fungi) | 31 |
| Seagrasses | 43 |
| Mangroves | 42 |
| GENERAL ECOLOGY | 85 |
| General Review/Bibliography | 11 |
| Energetics, energy flow, production | 16 |
| Nutrients, organic detritus | 4 |
| Limiting/regulatory factors | 42 |
| Modelling | 2 |
| Plankton | 13 |
| GEOGRAPHIC AREA | 681 |
| General Review/Bibliography | 4 |
| Florida Bay | 406 |
| Everglades Estuary | 166 |
| Big Cypress Estuary | 105 |
| GEOLOGY | 193 |
| General Review/Bibliography | 18 |
| Coastal Processes | 10 |
| Bedrock | 6 |
| Geochemistry | 28 |
| Geologic History | 10 |
| Mineralogy | 7 |
| Palynology | 6 |
| Peat Deposits | 26 |
| Sea Level Rise | 33 |
| Sediments | 118 |
| Stratigraphy | 14 |
| HYDROMETEOROLOGY | 80 |
| General Review/Bibliography | 10 |
| Air Temperature | 14 |
| Wind | 8 |

Table 2, continued.

| SUBJECT | NUMBER OF CITATIONS |
|---|---|
| Clouds | 4 |
| Groundwater, water level, flow | 43 |
| Hurricanes/Storms | 11 |
| | 22 |
| POLLUTION | |
| Pesticides | 12 |
| Metals | 14 |
| WATER QUALITY | 118 |
| General Review/Bibliography | 2 |
| Dissolved Oxygen | 23 |
| pH | 25 |
| Salinity | 100 |
| Temperature | 84 |
| Turbidity | 6 |
| Chemical Data | 4 |
| ZOOLOGY | 257 |
| General Review/Bibliography | 21 |
| Non-fishery spp. | 46 |
| Sport/Commercial Fishery spp. | 124 |
| Gray Snapper | 27 |
| Mullet | 9 |
| Pink Shrimp | 53 |
| Red Drum | 19 |
| Seatrout | 25 |
| Snook | 17 |
| Spiny Lobster | 9 |
| Stone Crab | 15 |
| Echinodermata | 7 |
| Mollusks | 12 |
| Foraminifera | 16 |
| Miscellaneous Invertebrates (Crustaceans/Polychaetes) | 17 |
| Mammals | 16 |
| Manatee | 8 |
| Dolphin | 8 |

Table 2, continued.

| SUBJECT | NUMBER OF CITATIONS |
|---|---|
| Reptiles | 28 |
| Crocodile | 18 |
| Endangered Species | 33 |

*Literature Search*

The bibliographic search was predominantly done at the South Florida Research Center (SFRC), ENP and at the University of Miami's Rosensteil School of Marine and Atmospheric Sciences (RSMAS). I began at the SFRC by assembling marine archival materials (e.g., raw data sets, correspondence, maps, etc.), and published and unpublished research results from major scientific studies conducted by National Park Service (NPS) researchers and contractors in coastal and estuarine areas of ENP. No starting date was established for the references in the present compilation.

Several bibliographies were particularly rich in sources on the south Florida region and subject matter: Tabb and Iversen (1971, no. 411 in bibliography), Houde (1971, no. 167), and Mahadevan et al. (1984, no. 224). Tabb and Iversen (1971) and Houde (1971) compiled tables of over 60 journals and sources that were searched systematically for citations back to 1960, and a few that were searched to their origin (Bulletin of Marine Science, Florida Scientist, etc.). Nearly all of these journals and sources were reviewed again, systematically, and updated by the author when assembling citations for the Schmidt and Davis (1978, no. 354) report. For the period 1978-1983, good use was made of the Mahadevan et al. (1984) bibliography. They conducted numerous computer-assisted searches on various biological and earth science data bases. For a fairly complete compilation of references on Florida Bay, the reader is directed to the January 1989 issue

of the Bulletin of Marine Science and references cited therein. An additional source of information includes abstracts from a Symposium on Florida Bay held in June 1987 at the University of Miami. These abstracts are not referenced here. In some cases abstracts were obtained from secondary sources such as the University of Georgia's (1973, no. 519 in addendum) geological inventory and are indicated as such. There are undoubtedly other articles that should be added to this bibliography and if omission of valuable references occurred by oversight, they can be added in a later volume or addendum.

The ENP library was searched. Another helpful literature source was Don Deis of Continental Shelf Associates under contract to the South Florida Water Management District (SWIM plan), who provided a list of scientific references from inshore/offshore areas of Florida Bay. However, only 20 of these references, mostly geological and climatological citations, had not been discovered in my manual and on-line database searches. Theses, dissertations, and journal articles were reviewed at the University of Miami (RSMAS) library. At RSMAS I used a computerized, on-line search service, Cambridge Scientific Abstracts, covering all parts of Aquatic Sciences & Fisheries Abstracts (ASFA), that provided a list of 15 pertinent citations for the period 1980-1988. Lists of theses and dissertations were also obtained for the University of Florida and Florida State University. An on-line database search was also initiated at the Department of Interior's Natural Resources Library in Washington, D.C. Interlibrary loans were used to obtain those pertinent theses and dissertations retrieved from the abstracted literature and pertinent journals. Theses and dissertations, as well as bibliographies of review articles obtained, usually contained large literature cited sections and were an excellent source of additional references.

In this report journal articles formed the bulk of the listed references (276), but 70 MS and Ph.D. theses were also included along with 115 technical reports (Table 3). As mentioned

earlier, the Bulletin of Marine Science was a highly important outlet for research in this area. Publications from the Comparative Sedimentology Laboratory of the University of Miami (RSMAS) were an important source for understanding the local geology of this region. Except where noted in the bibliography, copies of all references used in this compilation are located at the SFRC.

Table 3. Number of citations by form of material.

| FORM | NUMBER OF CITATIONS |
|---|---|
| Journal articles | 276 |
| Reports-technical | 115 |
| Master theses | 42 |
| Dissertations | 28 |
| Conference Proceedings | 23 |
| Books (including book chapters) | 8 |
| Popular article | 1 |

Particular emphasis was placed on examining sampling methodology in those citations used in the bibliography. Even when published papers were based on graduate theses/dissertations, both were included because critical details in methods are missing or are often condensed in the published works. In many cases, when earlier (prior to the 1970's) data sets were examined, it was found that methods were often poorly described or not described at all. These data characteristics are especially important in determining the geographic scope of the study examined, type of data collected, sampling gear used, numbers of sampling stations and their locations, etc., and can be very helpful in establishing links among the data sets examined. Over the last decade, however, most of the studies examined have focused on better scientific controls and standards.

Literature obtained was abstracted onto a standardized form and edited. Descriptive annotative information (when available) extracted from each citation and footnoted with each abstract consisted of:

1) Complete Citation (author(s), year, title, document type, publisher, and/or number, pages).
2) Abstract describing principal objectives and findings of study.
3) Study Period (period in time or actual dates).
4) Habitat/Substrate Characteristics (e.g., bay, channels, mudbanks and/or seagrass, mud, sand, etc.).
5) Study Type (e.g., quantitative, qualitative).
6) Biological Component (Flora & fauna).
7) Gear Type (trawl, seine, core, grab, etc.).
8) Number of Stations (Within and/or outside of park boundary).
9) Number of Replicates/Station
10) Temporal Frequency (collection interval).
11) Abiotic Parameters Measured (e.g., salinity, temperature, etc.).
12) Dominant Taxon/Taxa Studied (Name or names of species).

The citations and abstracts were entered onto an IBM-PC compatible computer and edited, sorted, and printed using a bibliographic database system, PROCITE.

Acronyms used herein are ENP (Everglades National Park), NPS (National Park Service), BNP (Biscayne National Park), FOJE (Fort Jefferson National Monument), VINP (Virgin Island National Park), FWS (Fish and Wildlife Service), BSF&W (Bureau Sport Fisheries and Wildlife, EPA (U. S Environmental Protection Agency), USGS (U.S. Geological Survey), RSMAS (Rosensteil School of Marine and Atmospheric Sciences), SFRC (South Florida Research Center), CSA (Continental Shelf Associates).

ACKNOWLEDGEMENTS

Special acknowledgement is extended to K. Hale, Dr. H. Albertson, and F. Martin of the RSMAS library staff who generously helped in obtaining many publications and provided for the use of on-line abstracting services. I also thank E. B. Thue, acting Librarian of the ENP reference library, for her assistance in obtaining inter-library loans, F. Draughn for producing the figure, and C. Doffermyre for typing tables and editing the manuscript. Finally, I thank my colleagues at the SFRC, J. C. Ogden, W. F. Loftus, and M. B. Robblee, who took a personal interest in adding to the bibliography and offered valuable comment. Two anonymous reviewers suggested improvements in the manuscript.

1. Aisner, J. A. 1980. Origin and development of Arsenic Bank, a Holocene biotherm in southwestern Florida Bay. Geol. Soc. Am., Abstr. Prog. 12(4):169.

Arsenic Bank is a Holocene biotherm located 9 km north-northwest of Long Key in Florida Bay (ENP). Fourteen cores were used to determine stratigraphy and depositional environments of the shoal. Surficial sediment was analyzed for recent modes of sedimentation and biotic communities. The bank is composed of alternating beds of coarse coral, algal, and molluscan debris covered by a thick carpet of *Thalassia*, *Porities*, *Halimeda*, and sponges which allows for sediment entrapment, shoal growth and stability. These current and wave resistant organisms form a loose framework for molluscan and Halimeda sediment entrapment. Textural data suggests that modes of transport have not changed during the formation of the bank. These modes include in situ accumulation of wave-generated debris, including Pleistocene rock fragments, from adjacent areas. These rock fragments show that storms account for significant episodic deposition on the mound. Vertical and lateral accretion is also caused by sediment-trapping organisms.-Adapted from author's abstract.

2. Aisner, J. A. 1980. Origin and development of Arsenic Bank, a Holocene biotherm in southwestern Florida Bay. Fla. Sci. 43 (suppl. 1):43-44. (Abs.).

Narrative same as in reference no. 1.

3. Aisner, J. A. and S. B. Upchurch. 1981. Genesis of a skeletal mound. Geol. Soc. Am., Abstr. Progr. 13(7):394.

Arsenic Bank is a series of Holocene carbonate mounds located in the southwestern Florida Bay portion of ENP. Surficial sediment samples and 14 cores from a mound in the middle of the bank chain indicate that the depositional history of the mound is deposition of (1) a basal, polyhaline facies; (2) an upper, normal marine facies; and (3) a storm facies. These facies document the Flandrian transgression in southwestern Florida Bay. The basal facies consists of muddy sands which accumulated in bedrock depressions about 3,200 years ago and were colonized by *Thalassia* and brackish-water tolerant fauna. The marine facies is composed mostly of beds of coral, algal, and molluscan sediment. Growths of *Thalassia*, *Porities*, and sponges allowed for baffling of waves and currents and formed a loose, interlocking framework in which sediment was trapped. Episodic storms account for significant concentrations of coarse-grained sediment within the marine facies. Textural data indicate that modes of sedimentation include autochthonous accumulations of skeletal debris and bedrock fragments. Vertical and lateral accretion is also caused by sediment-trapping organisms.-Adapted from author's abstract.

4. Allen, D. M. and T. J. Costello. 1966. Releases and recoveries of marked pink shrimp, *Penaeus duorarum*, in south Florida waters, 1958-1964. U.S. Fish and Wildl. Serv., Data Rep. 11, 77 pp., on two microfiches.

Pink shrimp were captured, stain-marked, and released for recapture in 17 experiments in the following areas: Flamingo, Peterson Keys, Shark River and Bottle Key in ENP; Biscayne Bay, Lower Matecumbe Key, Barnes Sound, Hawk Channel, Pine Island Sound, Tortugas Grounds, Sanibel Grounds, and Indian Key. Data reported includes location, date of release and recapture of shrimp, number, size, and sex of shrimp, and the stains used.

Study Period:1958-1964; Habitat:Variable; Study Type:semi-quantitative; Biological Component:Penaeid shrimp; Gear Type:Roller frame trawl and wing net; Dominant Taxon/Taxa Studied:*Penaeus duorarum*.

5. Allen, D. M., J. H. Hudson and T. J. Costello. 1980. Postlarval shrimp (*Penaeus*) in the Florida Keys: Species, size, and seasonal abundance. Bull. Mar. Sci. 30:21-33.

Postlarval penaeid shrimp were studied at Whale Harbor Channel in the Middle Florida Keys. Most postlarval shrimp were *P. duorarum*, occurred year-round, and were most abundant from April to September. Seasonal abundance was probably related to water temperature and the annual rise of sea level in the Florida Bay area. Seasonal abundance of postlarvae at Whale Harbor Channel were closely related to abundance of early juveniles (*P. duorarum*) on the Florida Bay (ENP) nursery grounds.

Study Period:January 1966 to August 1968; Habitat:Water column and grass beds; Study Type:semi-quantitative/quantitative; Biological Component:Penaeid shrimp; Gear Types:Plankton nets (postlarvae), 0.5 m benthic sled net (juveniles); Temporal Frequency:Monthly; Abiotic Parameters Measured:Wind speed and direction, temperature, salinity, and current velocities; Dominant Taxon/Taxa Studied:*P. duorarum*.

6. Allen, D. M. and J. H. Hudson. 1970. A sled-mounted suction sampler for benthic organisms. U.S. Dept. of Interior, Fish and Wildl. Serv., Spec. Sci. Rep., Fish. No. 614, 5 pp.

The sampler is an underwater vacuum device mounted on a sled; a venturi-type water dredge provides suction. This equipment collects quantitative samples of young pink shrimp, *Penaeus duorarum*, and is effective in capturing other small benthic organisms. Shrimp catching efficiency was compared with that of a benthic sled net in Florida Bay (ENP).

Study Period:1966-67; Habitat:Firm sand, mud, grassbed; Type of Study:Quantitative; Biological component:Fauna; Gear Type:Suction sampler, benthic sled-net; Dominant Taxon/Taxa Studied:*P. duorarum*.

7. Anonymous. 1980. Pesticide use observations, Monroe County, Florida, March - June 1979. USEPA, National Enforcement Investigations Center (NEIC). Denver, CO. 36 pp.

A study into the use of insecticides for mosquito control in Monroe County, Florida including Key Largo and the marine environment of ENP was conducted

March-July 1979. The pesticides studied included the organophosphate insecticides, Baytex and Naled (Dibrom 14) using water, air and faunal (invertebrates/fish) samples. Naled is applied aerially and Baytex by ground application along U.S. Hwy 1 between Key Largo and the Florida mainland. The NPS contends that these pesticides enter ENP in water currents, food chains, overspray, drift, or runoff, causing damage to the park and adjacent marine environments, particularly to the bait shrimp industry and local commercial fisheries. It was found that limited precipitation during the study period and the consequent diminishing of mosquito control activities by Monroe County probably reduced an observable pesticide impact on the ENP marine environment. However, indication of pesticide intrusion into the park or adjacent marine waters were recorded six times involving Baytex/Naled suggesting that more precise application practices should be adopted by the Mosquito Control District. Improper disposal of used containers by the District was also noted.

Study Period:March, June-July, 1979; Study Type:Qualitative; Number of Stations:March (9), June (10), July (2) in ENP; Number of Replicates/Station:1-3; Habitat:Bays, creeks, canals; Biological Component:Fauna; Abiotic Parameters Measured:Pesticides (Naled, Baytex), diesel oil, water temp., salinity, pH, DO, sediment characteristics; Dominant Taxon/Taxa Studied:*Lagodon rhomboides*, *Penaeus duorarum*, *Crassostrea virginicus*.

8. Ball, M. M., E. A. Shinn and K. W. Stockman. 1967. The geologic effects of Hurricane Donna in south Florida. J. Geol. 75(5):583-597.

This paper discusses the effects of the passage of hurricane Donna (September 9-10, 1960) across south Florida in an area where detailed data on pre-storm sea-floor conditions existed. Much of the work in this paper was directed towards storm effects along the Florida reef tract. Elsewhere in Florida Bay (ENP), the ebb of the storm tides left large amounts of layered lime mud stranded on the supratidal flats. Sites discussed in Florida Bay include Whale Harbor Channel, Crane Key, Cross Bank, Sandy Key as well as the Florida mainland where mud deposits extended up to five miles inland. The large extent of the supratidal flats results from: (1) the ability of storm tides to strand sediment over large areas, (2) the inaccessibility of the tidal flat to processes that could rework the sediment into adjacent marine environments, and (3) the supply of the tidal-flat sediments at the expense of adjacent marine facies that compete with tidal-flat sediments for a place in the geologic record. The banks of Florida Bay were not greatly affected by storm-wave erosion and are more wave resistent than corals of patch reefs. The authors conclude that although such events may be catastrophic in terms of a man's lifetime, they are only commonplace events in terms of geologic time.

Study Period:September 1960; Study Type:Qualitative; Habitat:Mud bank, coral reef.

9. Barros, N. 1987. Food habits of bottlenose dolphins (*Tursiops truncatus*) in the southeastern United States, with special reference to Florida waters. M.S. Thesis, Univ Miami, Coral Gables, Florida. 139 pp.

Studies on the food habits of 44 bottlenose dolphins, *Tursiops truncatus*, from strandings along the SE and Gulf coasts of the US, indicate that fish were the most

common item. Important gamefish prey included silver seatrout, *Cynoscion nothus*, silver perch, *Bairdiella chrysoura*, sand seatrout, *Cynoscion arenarius*, and croaker, *Micropogonais undulatus*, which suggests competitive interactions between dolphins and fisheries. Sand seatrout, mullet, silver perch, silver seatrout, and pigfish were among the most important fish species in the diet of dolphins examined from the west coast of ENP.

Study Period:1973-1987; Study Type:Qualitative; Habitat:Inshore/offshore; Dominant Taxon/Taxa Studied:*Tursiops truncatus*.

10. Beardsley, G. L., Jr. 1967. Distribution in the water column of migrating juvenile pink shrimp, *Penaeus duorarum*, Burkenroad in Buttonwood Canal, Everglades National Park, Florida. Ph.D. Dissertation., Univ. of Miami, Coral Gables, Florida. 91 pp.

Distributional studies on migrating pink shrimp showed that they occurred in the Buttonwood Canal at various times. Shrimp were found on the surface of the canal under all conditions based on an analysis of the relation between environmental factors and distributional patterns. However, a greater percentage were observed on the surface during full moon periods. Evidence from Coot Bay also indicated that juveniles respond positively to moonlight during their emigration. No differences in vertical distribution were detected in relation to temperature, salinity, current velocity, changed in water depth, or sex. Changes in lateral distribution, however, occurred in the canal. When moving out with the tide, juveniles commonly cling to drifting vegetation, and their distribution is probably affected by prevailing winds when large amounts of vegetation are present in the water. At other times current patterns showed no features that might contribute to changes in lateral distribution. Mean carapace length and sex ratios were determined.

Study Period:1964-1965; Habitat:Water column; Study Type:Qualitative; Biological Component:Penaeid shrimp; Gear Type:Wing nets; Abiotic Parameters Measured:Temperature, salinity, current velocity, depth; Dominant Taxon/Taxa Studied:*Penaeus duorarum*.

11. Beardsley, G. L., Jr. 1970. Distribution of migrating juvenile pink shrimp, *Penaeus duorarum*, Burkenroad, in Buttonwood Canal, Everglades National Park, Florida. Trans. Am. Fish. Soc. 99(2):401-408.

The vertical and lateral distribution of migrating pink shrimp, *Penaeus duorarum*, was studied in Buttonwood Canal by thrice monthly sampling with conical nets suspended from a bridge. Vertical and horizontal movements of juveniles correlated with moonlight and tide. During ebb tide, juveniles exhibited a positive response to moonlight, by moving to the surface. During flood tides they stayed on the bottom or at the sides of the canal.

Study Period:June 1964-June 1965; Study Type:Quantitative; Biological Component:Penaeid shrimp; Gear Type:Conical nets; Number of Stations:5; Number of Replicates/Station:3; Temporal Frequency:3 x month; Abiotic Parameters Measured:Current velocity, salinity, temperature, depth; Dominant Taxon/Taxa Studied:*Penaeus duorarum*.

12. Beccasio, A. D., N. Fotheringham, A. E. Redfield and et al. 1982. Gulf coast ecological inventory: user 's guide and information base. Washington D.C. Biological Services Program, U.S. Fish and Wildl. Serv. 191 pp.

This report provides an inventory of important ecological resources along the Gulf coast, including ENP. It is intended to provide government and industry decision-makers with ecological information to assist them in the determination of impacts from the coastal sitings of oil- and energy-related facilities. Major goals of the inventory include review and analysis of coastal fish and wildlife data and habitats, develop data formats compatible with 1:250,000 mapping scale, the preparation of a report narrative keyed to resource inventory graphics. Ecological resources are summarized by geographic zone and descriptions and locations of species with special status and species of high commercial, recreational and aesthetic value are included.

Study Type:Qualitative (review).

13. Berner, R. A. 1967. Comparative dissolution characteristics of carbonate minerals in the presence and absence of aqueous magnesium ion. Am. J. Sci. 265(1):45-70.

Short term (5-25 hrs) steady state pH has been measured for the dissolution of reagent grade calcite, Deep Spring Lake dolomite, and Florida Bay (no specific location given) sediment (aragonite plus 14 mode mole percent Mg calcite) in distilled water and 0.1 molal $MgCl_2$ solution at 25°C and constant $P_{co2}$ (1 atm and 10-2.51 atm). Results indicate that calcite and dolomite can each show a constant ion activity product in the presence and absence of high concentrations of dissolved $Mg^{++}$ if unground samples are used and steady state approached from undersaturation. Unground Florida Bay sediment does not show simple reversible behavior in either solution. The solubility in distilled water is affected by the amount of surface area exposed to the solution. Dissolved $Mg^{++}$ causes a definite depression in the steady state pH and ion activity product of Florida Bay sediment below values predicted from the measured pH in distilled water at the same $P_{co2}$. Inhibition of low-Mg calcite nucleation may result in a reversible equilibrium with Mg ions and the grain surfaces.

Study Type:Quantitative; Abiotic Parameters Measured:Sediment characteristics.

14. Berner, R. A. 1966. Diagenesis of carbonate sediments--Interaction of magnesium in sea water with mineral grains. Science 153:188-191.

Samples of natural fine-graded carbonate sediment from Florida Bay (No specific location given), Florida undergo mole-for-mole cation exchange with aqueous solutions of $MgCl_2$ and $CaCl_2$ in the laboratory. The exchange reaction, which involves the surface of the grains of sediment, can be essentially described by a simple mass action-law equation. Enrichment of $Mg^{++}$ beyond the amounts found within particle interiors should take place on the surface of $CaCo_3$ sediments immersed in sea water; it may be on both exchangeable and unexchangeable sites.

Study Type:Quantitative; Abiotic Parameters Measured:Sediment characteristics.

15. Bert, T. M. 1985. Geographic variation, population biology, and hybridization in *Menippe mercenaria* and evolution in the genus *Menippe* in the southwestern North Atlantic Ocean. Ph.D. Dissertation, Yale Univ., New Haven, Conn. 305 pp.

Electrophoretically detectable variation in 40 proteins, color morphology, and field studies involving trapping and SCUBA (primarily within the boundaries of ENP) were used to determine the evolutionary relationships of crabs of the genus *Menippe* (Xanthidae) in the southeastern United States. Observed patterns of geographic variation in genotype and phenotype are the product of the influence of Late Cenozoic changes in climate and geology. Based on allele frequencies (= genotype) and color morphology (= phenotype), it was found that *M. mercenaria*, is a taxonomic supergroup, composed of two taxa. One is distributed from northwest Florida westward through Texas while the second ranges in its pure form, through the Florida peninsula from northwest to east central Florida, and in North Carolina. The taxa hybridize in the Gulf of Mexico (NW Florida) and in the Atlantic Ocean (east central Florida to South Carolina). The Atlantic hybrid zone was formed prior to the closure of the seaway across north Florida connecting the Gulf of Mexico and the Atlantic, and the NW Florida zone at some time subsequent to that closure. A discussion is presented on the evolution of *Menippe* based on the geographic pattern of allele frequencies and color morphology as integrated with population ecology and reproductive biology for each of the two regions. Of the three separate studies conducted on the population dynamics and biology of *Menippe* in nearshore south Florida waters, two were conducted in ENP.

Study Period:In ENP, trapping-(Jun 1979-Jun 1980), traps/SCUBA-(Mar-Nov 1980 & 1981); Study Type:Qualitative, quantitative: Gear Type:Traps, tags, SCUBA; Number of Stations:In ENP, trapping-17, traps/SCUBA-2; Temporal Frequency:Lunar cycle/full moon; Number of Replicates/Station:Variable; Habitat:Coastal; Abiotic Parameters Measured:Salinity, temperature, water depth; Biological Component:Xanthid crab; Dominant Taxon/Taxa Studied:*M. mercenaria*.

16. Bert, T. M., J. W. Dodrill, G. E. Davis and J. T. Tilmant. 1983. The population dynamics of the stone crab (*Menippe mercenaria*) in Everglades and Biscayne Parks. Fla. Sci. 46 (Suppl. 1):24. (Abs.).

Temporal and spatial variations in the distribution, abundance, sex ratio, size class frequency, and reproduction of stone crabs (*Menippe Mercenaria*) were studied in south Florida nearshore waters including ENP. A major nursery area for stone crabs was discovered offshore from the Big Cypress and Everglades estuaries. It was hypothesized that crabs from that area disperse southward through Florida Bay and the Florida Keys. Stone crabs trapped in BNP were not locally recruited, but may be migrating from further north along the Florida east coast.-Adapted from authors' abstract.

17. Bert, T. M. and J. M. Stevely. 1989. Population characteristics of the stone crab, *Menippe mercenaria*, in Florida Bay and the Florida Keys. Bull. Mar. Sci. (Abstract). 44:515.

Stone crabs are high level carnivores that exhibit sexual dimorphism and support an important commercial fishery in southwest Florida. Our information on distribution and abundance, habitat use, and reproductive patterns in western

Florida Bay (ENP) and the Florida Keys was obtained from quantitative diving surveys. Stone crab density was highest on the Gulf of Mexico side of the Middle Keys and lowest on the Atlantic side of the Upper Keys. Mean size of males was largest in western Florida Bay and smallest on the Gulf side of the Keys; female mean size was smallest on the nearshore Atlantic side and largest in western Florida Bay and offshore on the Atlantic side. Density was highest in mixed rock/seagrass habitat, where stone crabs occur in greater densities in holes and under hard substrates than in seagrass burrows. Females apparently inhabit rock/seagrass preferentially, whereas males apparently prefer mixed rock/sand habitat. Seasonal habitat occupancy changed between sexes and with proportion of habitat types available. Mating pairs occurred during spring and fall throughout the study area. The population structure of stone crabs suggests territorality and/or habitat dominance related to reproductive patterns.-Adapted from authors' abstract.

18. Bert, T. M., J. T. Tilmant, J. W. Dodrill and G. E. Davis. 1986. Aspects of the population dynamics and biology of the stone crab (*Menippe mercenaria*) in Everglades and Biscayne National Parks as determined by trapping. Rept. SFRC-86/04. Homestead, FL., Everglades N.P., South Florida Research Center. 77 pp.

Spatial and temporal variations in the distribution, abundance, size class frequency, sex ratio, and reproductive activity of stone crabs *Menippe mercenaria* was studied in south Florida coastal waters and existing knowledge of the species was synthesized. Abundance of juveniles and adults was highest and mean size was smallest from Lostman 's River northward. Abundance decreased and mean size increased with movement southward through Florida Bay. Juvenile distribution and abundance was directly related to abundance of adults and proportion of females in the trapped population. BNP resembled Florida Bay in number and size of adults and lack of juveniles. Temporal changes in abundance, sex ratio and size class frequency of adults were correlated to reproductive activity and water temperature and corresponded to commercial fishing season offshore, and in Florida Bay. Females bear eggs in summer and become sexually mature by age three. Molting occurs from fall through spring in females, increase in CW by 10 mm with each molt and can live to age seven. Males may molt year-round with a mean molt increment increase of 16 mm CW for crabs greater than 70 mm CW. Males undergo a greater mortality rate than females apparently due to their greater susceptibility to commercial fishing pressure.

Study Period:June 1979-June 1980; Study Type:Quantitative; Biological Component:Xanthid Crab; Habitat:Mud, sand, shell, rock, coral; Gear Type:Crab Trap; Abiotic Parameters Measured:Salinity, water temp; Dominant Taxon/Taxa Studied:*Menippe mercenaria*.

19. Bielsa, L. M., H. Murdich and R. F. Labisky. 1983. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (south Florida) -- pink shrimp. U.S. Fish Wildl. Serv. FWS/OBS-82/11.17. U.S. Army Corps of Engineers, TR EL-82-4. 21 pp.

A review is presented of the life history and environmental requirements of pink shrimp inhabitating south Florida estuarine and marine waters, including ENP.

General notes on morphology and identification aids are given. Life history aspects - sexual maturity, spawning, larvae, postlarvae, juveniles, and adults are described. Characteristics of the commercial fishery are discussed. The ecological descriptions and environmental requirements of this species are broken down by salinity, temperature, habitat, water movement, and light.

Habitat:Estuarine and marine; Study Type:Qualitative, review; Dominant Taxon/Taxa Studied:*Penaeus duorarum*.

20. Bock, W. D. 1971. A handbook of the benthonic foraminifera of Florida Bay and adjacent waters. Pages 1-72 IN: W.D. Bock, G.W. Lynts, S.L. Smith, R.C. Wright, W.W. Hay, and J.J. Jones, eds. A symposium of recent south Florida Foraminifera. Miami Geol. Soc. Publ., Miami, Fla. 245 pp.

Sediment samples from 108 stations in and around Florida Bay (ENP) were examined for their benthonic foraminiferal content. Most sites in ENP were located in southwestern Florida Bay. A total of 235 species belonging to 99 genera were identified. Five faunal groups were recognized which were characteristic of different environments: the Straits and Gulf faunas controlled by depth; the back-reef and bay faunas controlled by salinity and temperature; and the brackish-water fauna controlled primarily by salinity. The bay fauna's distribution appears to be secondarily controlled by wave and current action.

Study Period:1958-63; Study Type:Qualitative; Gear Type:Cores, dredges, hand; Number of Stations:108 (Approx. 85 were in ENP); Habitat:Bottom sediment; Biological Component:Foraminifera; Dominant Taxon/Taxa Studied:Bay fauna (*Articulina* sp.).

21. Bosence, D. 1989. Biogenic carbonate production in Florida Bay. Bull. Mar Sci. 44:419-433.

This study reviews previous work on biogenic carbonate production within Florida Bay (ENP) and examines new data on production from Upper Cross Bank and Buchanan Key areas. Production figures for bank and lake environments are calculated from standing crop surveys and growth rates determined from published work and growth measurements. The organisms studied are: *Porities*, *Thalassia*, epibionts, molluscs, *Penicillus*, foraminifera, and *Halimeda* listed in decreasing order of carbonate productivity. Results indicate that banks produce twice as much skeletal carbonate as lakes per unit area, however, lakes are larger than banks and generate about four times as much sediments as that formed on banks. This excess sediment is transported to the southwest part of the bay or out of the bay system. The Cross Bank generates sediment at a slower rate than those of the more stable Buchanan bank. Production rates may therefore be effecting bank stability.

Study Period:September 1985; Study Type:Qualitative; Gear Type:50 x 50 cm quadrats; Number of Stations:Upper Cross Banks (496), Buchanan Keys (337); Habitat:banks and basins; Biological Component:Carbonate producers (*Porities*, *Thalassia*, *Penicillus Halimeda*, epibionts, molluscs, foraminifera); Dominant Taxon/Taxa Studied:*Thalassia*, *Porities*, *Penicillus*, *Halimeda*, Molluscs, Foraminifera.

22. Bosence, D. 1989. Surface sublittoral sediments of Florida Bay. Bull. Mar Sci. 44:434-453.

This study reviewed previous work on the surface sediments of Florida Bay (ENP) and made a detailed analysis of sediments from the Cross Banks and Buchanan Keys area. Sediments of the Cross Banks area are composed mostly of mollusc and foraminifer grains with a pelleted, silt sized matrix. Bank textures vary from windward mud-pebble-conglomerates, packstones, and grainstones to bank-top leeward, and lake, wackestones and mudstones. Sediments of the Buchanan Banks area comprise grains of Halimeda, coral and lithoclasts in addition to mollusc and foraminifera grains. Windward facies are packstones, grainstones and some *Porities* framestones. Sedimentary characteristics, seagrass rhizome depths and changes in bank morphology all indicate windward erosion and leeward deposition of mound sediment which supports recent hypotheses of down-wind bank migration and that this occurs in normal but sporadic weather conditions. Sediment composition and benthic communities show a trend of reducing diversity from the reef tract through central Florida Bay.

Study Period:1985-1987; Study Type:Qualitative; Gear Type:.5 $m^2$ quadrats, 40 x 30 cm boards; Number of Stations:600; Temporal Frequency:Thrice (Sept.1985, 1986, June 1987); Habitat:Surface sediment; Biological Component:Carbonate producers (seagrasses, green algae, molluscs, forams, and corals); Abiotic Parameters Measured:Water depth, sedimentary characteristics; Dominant Taxon/Taxa Studied:*Thalassia, Halimeda, Penicillus, Porities.*

23. Brook, I. M. 1978. Comparative macro-faunal abundance in turtlegrass (*Thalassia testudinum*) communities in south Florida characterized by high blade density. Bull. Mar. Sci. 28(1):213-217.

Five *Thalassia* communities with high blade density (>3000/$m^2$) were sampled by suction dredge in April 1973. Four sites were in BNP and one was at Murray Key in western Florida Bay (ENP). Macro-faunal abundance ranged from 292 to 10,728 individuals/$m^2$. The author suggested that high standing crop of seagrass may not be the primary determining factor in faunal abundance.

Study Period:April 1973; Study Type:Quantitative; Habitat:Grass beds; Biological Component:benthic flora and fauna; Number of Stations:5; Number of Replicates/ Station:4; Gear Type:.25 $m^2$ Suction Dredge; Temporal Frequency:once; Abiotic Parameters Measured:Salinity; Dominant Taxon/Taxa Studied:Mollusca, crustacea, polychaeta, Echinodermata, *Thalassia.*

24. Brook, I. M. 1981. Epibenthic and benthic sampling survey of the Whitewater Bay-Shark River estuary of Everglades National Park. Final Report, Part 2. for NPS Contract No. CXS 280-9-1593 to Univ. of Miami, RSMAS, Miami, Florida from Everglades National Park, South Florida Research Center. 74 pp.

A study of benthic communities in the Whitewater Bay-Shark River estuary of ENP was made during 1979 and 1980. In 1979 five monthly sampling sites showed no consistent relationship of abundance and species composition with seasonal variations in salinity. During 1980 an additional 21 stations in the original study areas were sampled to determine if original station data characterized the

community structure of larger areas of the estuary. All stations in Tarpon Bay, where salinity was always less than 5 ppt, had extremely low abundances and diversity. Abundance and species composition in Oyster Bay was similar in both years. Ponce de Leon Bay, with oceanic salinities, had the highest diversity and total taxa. Although abundance in Ponce de Leon Bay was usually low to moderate, it yielded the sample with the highest density (42,300/$m^2$). Original station data could not successfully predict taxonomic composition of the study areas; nearby stations were not taxonomically more similar than distant stations.

Study Period:1979-1980; Study Type:Quantitative; Habitat:Mud, shell, sand, rock; Number of Stations:5 (first year), 26 (second year); Biological Component:Benthic flora and fauna; Gear Type:Suction dredge; Number of Replicates/Stations:3; Temporal Frequency:Monthly; Abiotic Parameters Measured:Salinity, temperature; Dominant Taxon/Taxa Studied:Mollusca, crustacea, polychaeta, echinodermata.

25. Bryant, H. E., M. R. Dewey, N. A. Funicelli, G. M. Ludwig, D. A. Meineke and L. J. Mengel. 1989. Movement of five selected sports species of fish in Everglades National Park. Bull. Mar. Sci. (Abstract) 44:515.

Studies to determine movement of spotted seatrout, *Cynoscion nebulous*, red drum, *Sciaenops ocellatus*, gray snapper, *Lutjanus griseus*, black drum, *Pogonais cromis*, sheepshead, *Archosargus probatocephlus*, were conducted in Florida Bay and along the west coast of ENP. A total of 3,237 fish of the five species were tagged from March 1984 to March 1985; 1,797 individuals from Florida Bay and 1,440 individuals from the west coast were tagged. Spotted seatrout and red drum moved less than 6 and 8 km from the point of tagging, respectively. Gray snapper moved to the southwest with growth; mean distance traveled for these fish was 18,3 km. Black drum and sheepshead moved out of the park during winter.- Adapted from authors' abstract.

26. Caldwell, D. K. and M. C. Caldwell. 1973. Marine mammals of the eastern Gulf of Mexico. Pages III-1-1 to III-1-23. IN: Jones, L. J., R. E. Ring, M. O. Rinkel, and R. E. Smith, eds. A summary of knowledge of the eastern Gulf of Mexico. State Univ. Sys. of Florida, Inst. of Ocean., St. Petersburg, Fla.

This paper reviews and summarizes the limited information available on the life history, distribution, populations, rare or endangered status of marine mammals of the Gulf of Mexico, includes an annotated list of species with known records plotted on a map, and proposes further studies to learn as much about these mammals as possible. It is suggested that populations of all cetaceans are stable with only two species of dolphins subject to fishing pressure. Only two species (bottle-nose dolphin and manatee) utilize estuaries including those in ENP and perhaps are the most vulnerable to man 's activities.

Study Type:Qualitative, biological review.

27. Carter, M. R., L. A. Burns, T. R. Cavinder, K. R. Dugger, P. L. Fore, D. B. Hicks, H. L. Revells and T. W. Schmidt. 1973. Ecosystem analysis of the Big Cypress Swamp and estuaries. U.S.E.P.A. Region IV, South Florida Ecological Study, EPA 904/9-74-002. 429 pp.

This study examined natural and disturbed ecosystems in the Big Cypress Swamp and the Ten Thousand Islands including the West Pass area on the extreme western border of ENP. A detailed characterization of the study area was made including background data on chemical quality of waters and sediments; detrital transport and primary production for benthic plant communities, pesticide levels in water, sediments, fish and higher animals; and life histories of several freshwater and marine fish, particularly snook. Several detailed studies relating to man-made changes to the environment were conducted including salinity variations in natural versus man-influenced estuaries, and the effects of canals and other drainage on ground and surface waters. Ecosystem models of the upland terrestrial and estuarine systems in the study area were discussed.

Study Period:January 1972 to January 1973; Study Type:Quantitative/qualitative; Habitat:Estuarine, coastal marine in ENP; Biological Component:Flora & fauna; Gear Type:Nets, trawls, traps; Abiotic Parameters Measured:Salinity, temperature, current flow, depth, nutrients, rainfall, humidity, evapotransporation; Number of Stations:Variable (5 in ENP-salinity, tide, detrital concentration); Dominant Taxon/Taxa Studied:Snook.

28. Carter, P. W. and R. N. Mitterer. 1978. Amino acid composition of organic matter associated with carbonate and non-carbonate sediments. Geochim. Cosmochim. Acta 42(8):1231-1238.

Studies on carbonate sediment samples from the Florida Keys and Florida Bay (Cross Key Bank, ENP) and noncarbonate samples from Mexico Beach, Florida indicate that amino acids comprise 15-36% by wt of humic substances from these sediments. Humic and fulvic acids extracted from carbonate sediments are characterized primarily by the acidic amino acids aspartic and glutamic acid. From these sediments it was found that lower mol wt fractions have appreciably higher relative abundances of the acidic amino acids compared to higher mol wt fractions. Based on typical values for carboxyl group content in humic substances, acidic amino acids may be a significant contributor of these functional groups. Carbonate surfaces selectively adsorb aspartic acid-enriched organic matter while noncarbonates do not.

Study Type:Quantitative; Gear Type:Grab; Number of Stations:Variable; Habitat:Mud bank (ENP); Biological Component:Organic Carbon, nitrogen, fulvic and amino acids.

29. Casagrande, D. J. 1970. Geochemistry of amino acids in selected Florida peats. Ph.D. Dissertation. The Pennsylvania State Univ., University Park, Pa. 246 pp.

A description of the geochemistry of amino acids from marine peats in the Little Shark area of ENP is provided along with its associated mangrove vegetation (*Rhizophora mangle*).-Adapted from author's summary. A copy of this dissertation is on file at Penn. State Univ., University Park, Pa.

30. Casagrande, D. J. and P. H. Given. 1974. Geochemistry of amino acids in some Florida peat accumulations. I. Analytical approach and total amino acid concentrations. Geochim. Cosmochim. Acta. 41:419-434.

To understand the geochemical processes by which organs and tissues of higher plants are preserved in the peat accumulations of southern Florida, amino acids were isolated from peats and fractions thereof at two sites in the Florida Everglades. (One site was located at the mouth of the Little Shark River in ENP). For comparison, amino acids were also obtained by hydrolysis of organs of plants now providing the surface cover at the sites and of discarded plant parts in surface litter. It was found that the nature of the ecosystem is such that a small proportion of the carbon in macroflora accumulates as peat while nitrogen is re-worked but conserved. The greatest proportion both of the organic matter and of the amino acids were found in the humin fractions of the peat.

Study Type:Quantitative; Habitat:Coastal mangrove swamp (ENP); Number of Stations:2 (1 in ENP); Gear Type:Corer; Biological Component:Flora.

31. Casagrande, D. J., K. Siefert, C. Berschinski and N. Sutton. 1977. Sulfur in peat-forming systems of the Okefenokee Swamp and Florida Everglades: Origins of sulfur in coal. Geochim. Cosmochim. Acta 41:161-167.

An assessment was made of six sulfur forms in peat-forming systems of Georgia and the coastal mangrove swamp (Little Shark River area) in ENP. Results indicated that the levels of total sulfur found (0.1-10%) were indicative of a major incorporation of sulfur in the early stages of coal formation. Hydrogen sulfide and elemental sulfur quantities were indicative of whether marine or fresh water conditions prevailed at the time of deposition. The levels of sulfur forms in the peat profiles are compared to those observed in living plants and to various coals; levels of pyrite and organic sulfur in the peat are similar to those found by other investigators in freshwater-derived and marine-derived coals.

Study Type:Quantitative; Number of Stations:One in ENP, Little Shark River; Habitat:Coastal mangrove swamp (ENP); Biological Component:Peat(*Rhizophora*).

32. Centaur Associates, Inc. 1979. Socioeconomic assessment for fishery management, Everglades National Park. Report T-543. Homestead, FLa., Everglades N.P., South Florida Research Center. 105 pp.

This report presents the socioeconomic impact assessments and adverse effects from restrictions on commercial and recreational fishing activities in ENP. ENP is unique with respect to fishery resources and fishery management. Florida Bay has been subject to a considerable degree of commercial and recreational pressure. The issuance of commercial fishing permits are nearly equally divided between Florida Bay and the Everglades City area while recreational and guide and charterboat fishing is an important attraction primarily in the Flamingo - Florida Bay area. Although all commercial and recreational fishing is done in accordance with state regulations, intense competition exists between both factions with the result that the NPS explore alternative management options for the park's fishery resources. These actions which require consideration as they affect 3 South Florida counties and in relation to 24 fishery management alternatives are assessed as follows: prohibition of net fishing, bag limits and harvest sizes of major gamefish species, prohibited harvest of stone crabs and spiny lobster and commercial permits, boat and motor restrictions, and financial and non-financial impacts are given for each management action.

Study Type:Fishery assessment report; Habitat:Estuarine and coastal marine; Dominant Taxon/Taxa:Red drum, spotted seatrout, gray snapper, snook, spiny lobster, stone crab, mullet.

33. Charlton, D. S. 1981. The characterization and evolution of carbonate tidal deltas, upper Florida Keys. Ph.D. Dissertation. The University of Wisconsin, Madison, Wis. 421 pp.

South Florida was inundated by the last sea-level rise, initiating tidal exchange between Florida Bay (ENP) and the open ocean at bedrock lows along the Florida Keys. Carbonate tidal deltas, composed of mangrove peat and carbonate sediments, formed during the last 5000 years seaward and bayward of tidal channels at Snake Creek, Whale Harbor, and Tavernier Creek. This study, which focused on the tidal flats at Snake Creek, identified six surface depositional zones of the Snake Creek bayside delta, representing environmental gradients from the most restricted circulation to open marine conditions. Snake Creek delta provides a microcosm of regional gradients from the Everglades, across Florida Bay, to Hawk Channel. This zonation and a similar approach for ocean-side tidal deltas were used to interpret Holocene cores along nine cross sections at Snake Creek, Whale Harbor, and Tavernier Creek.-Adapted from author's abstract. A copy of this dissertation is located at the Univ. of Wisconsin, Madison, WI.

34. Chen, A. S. 1971. Flavonoid pigments in the red mangrove, *Rhizophora mangle L.* of the Florida Everglades and in the peat derived from it. M.S. Thesis, The Pennsylvania State Univ., University Park, Pa. 232 pp.

The red mangrove, common today in the coastal swamps of the Florida Everglades, is a member of a family, the Rhizophoraceae, known to be rich in tannins. It provides the major source of the peat deposited in the marine environments in the area. A study of the principal flavonoid substances in organs of *R. mangle* from 2 sites in the Little Shark/Joe River area of ENP, indicated that the main flavonoid constituents were leucoanthocyanidins; the principal leucoanthocyanidin in all organs was found to be leucocyanidin. Arguments were presented in support of the view that the tannin polymers do survive decay and incorporation into peat.

Study Period:Summer 1966, 1967; Study Type:Quantitative; Gear Type:Cores; Habitat:Coastal mangrove swamp; Number of Stations:2 sites (1967)in ENP; Temporal Frequency:Once; Dominant Taxon/Taxa Studied:*Rhizophora mangle.*

35. Chuensri, C. 1968. A morphometric and meristic study of postlarval brown shrimp, *Penaeus aztecus* Ives, pink shrimp, *Penaeus duorarum* Burkenroad, and white shrimp, *P. setiferus* (Linneaus). M.S. Thesis. Univ. of Miami, Coral Gables, Florida. 108 pp.

Specimens of *Penaeus aztecus, P. duorarum,* and *P. setiferus* were collected from the Florida Bay area (ENP), Key West, and Upper Matecumbe Key. A method was developed to easily separate the three species by using a new morphological character.

Study Period:1967-1968; Study Type:Quantitative; Biological Component:Penaeid shrimp; Habitat:Water column; Dominant Taxon/Taxa Studied:*P. duorarum, P. aztecus, P. setiferus.*

36. Clark, S. H. 1970. Factors affecting the distribution of fishes in Whitewater Bay, Everglades National Park, Florida. Ph.D. Dissertation, Univ. of Miami, Miami, Fla. 100 pp.

Also publ. as: Sea Grant Tech. Bull. No. 8, Univ. Miami Sea Grant Progr., Miami, Florida. 1-100 p. (1971).

During a 15-month period juvenile fish populations were studied in Whitewater Bay (ENP) using monthly roller frame trawl samples. Analysis of catch data performed on 15 of 68 species collected indicated a poisson distribution for the number of individuals per sample when densities were low and conformation to the negative binomial as populations increased. Variations among stations appeared to be closely related to differences in vegetation density.

Study Period:September 1968 November 1969; Study Type:Quantitative; Habitat:Sand, shell, marl, rock, grass and macro-algae beds; Biological Component:Fish and submerged vegetation; Gear Type:Roller frame trawl; Number of Stations:8; Number of Replicates/Station:14; Temporal Frequency:Monthly; Abiotic Parameters Measured:Salinity, temperature, dissolved oxygen; Dominant Taxon/Taxa Studied:*Eucinostomus gula, Orthopristis chrysoptera, Lagodon rhomboides, Bairdiella chrysoura.*

37. Clark, S. H. 1974. A study of variation in trawl data collected in Everglades National Park, Florida. Trans. Am. Fish. Soc. 103(4):777-785.

A one year study of trawl data variation was conducted at 8 stations in Whitewater Bay (ENP), using monthly roller frame trawl samples. A total of 52,190 fish, representing 64 species, were collected. Analyses of catch data performed on 15 of the most common species indicated a poisson distribution for the number of individuals per sample when sample densities were low and conformation to the negative binomial as populations increased. Variations among stations appeared to be closely related to differences in vegetation density. Although some evidence was given for a relationship between catch and sampling methods and tidal stage, no significant interaction was found.

Study Period:December 1968-November 1969; Study Type:Quantitative; Habitat:Sand, shell, marl, peat, rock, grass and macro-algae beds; Biological Component:Fish, submerged vegetation; Gear Type:Roller frame trawl; Number of Stations:8; Number of Replicates/Station:14; Temporal Frequency:monthly; Abiotic Parameters Measured:Salinity; Dominant Taxon Studied:same as in reference no. 36.

38. Cohen, A. D. 1968. Petrology of some peats of southern Florida (with special reference to the origin of coal). Ph.D. Dissertation, Pennsylvania State Univ., University Park, Pa. 352 pp.

This investigation of some peats of southern Florida, mostly within the estuarine areas of ENP, had three objectives: (1) to distinguish peat types using macroscopically observable characteristics; (2) to correlate each peat type with its modern environment of deposition; and (3) to identify the early stages in the transformation of peaty constituents to coal macerals. Based on the results of the analysis of 20 core and numerous surface samples, thirteen peat types were identified. Important conclusions concerning the composition and structure of the peats and the peatification of the plant parts within the peat were discussed. This study also confirms the theory of a relatively recent (5000 yrs. B.P.) transgression of the sea over this region.

Study Type:Qualitative; Habitat:Rivers, canals, bays, hammock; Number of Stations:20 (17 in ENP); Biological Component:Peats; Dominant Taxon/Taxa Studied:*Rhizophora, Avicennia, Mariscus.*

39. Cohen, A. D. and T. D. Davies. 1989. Petrographic/botanical composition and significance of the peat deposits of Florida Bay. Bull. Mar. Sci. (Abstract) 44:515-516.

The purpose of this study was to develop an understanding of the early vegetation and geologic history of Florida Bay (ENP) by analysis of the petrographic/botanical compositions of its surface and subsurface peat deposits. Over 600 sites were investigated, of which 134 were found to contain some peat. Most of these peat deposits were basal layers overlain by marine carbonate-rich marls. A representative selection of these peat deposits was sampled and analyzed using piston coring and microtome-sectioning procedures. Peat types representing 13 different autochthonous depositional environments were identified. Three of these represented marine, mangrove-dominated settings; two were transitional settings; and eight represented freshwater settings. The identification of freshwater peat types in all sites analyzed is significant because these types represent depositional settings that do not occur in Florida Bay today but which are currently forming on the mainland (in the Everglades). The evidence supports an hypothesis that the Florida Bay peat deposits represent erosional remnants of a more extensive area of freshwater Everglades-type peat that occupied portions of this region before it was converted to Florida Bay by a transgressing sea.-Adapted from authors' abstract.

40. Cohen, A. D. and W. Spackman. 1972. Methods in peat petrology and their application to reconstruction of paleoenvironments. Geol. Soc. Am. Bull. 83(1):129-142.

This study describes improved techniques for collecting and analyzing modern phytogenic sediments. A piston corer was developed to reduce compaction and hold the sediment in position in the coring tubes during downstroke and uplift. Peat samples were compared to modern plant tissues to identify genera and species of plants contributing to the peat. Using oriented microtome sections, it was possible to reconstruct the vegetational environment in which each peat layer in a core was deposited and thus to reconstruct the paleoecological history of the area. To validate the technique microtome sections of peat samples were compared to actual descriptions of the surface environments. Results indicated that surface peat corresponded quite closely to the vegetational zones which presently occupy

the surface swamp. It was concluded that both methods (palynologic/pollen counts and petrographic/peat slides) are superior to interpretations obtained by using either one alone.

Study Type:Quantitative/qualitative; Gear Type:Modified piston corer; Number of Stations:3 (ENP); Habitat:Coastal mangrove; Biological Component:Coastal and fresh-water open marsh vegetation; Dominant Taxon/Taxa Studied:*Rhizophora*, *Nymphaea*, *Mariscus*.

41. Cohen, A. D. and W. Spackman. 1974. The petrology of peats from the Everglades and coastal swamps of southern Florida. Pages 233-255 IN P.J. Gleason, ed. Environments of south Florida: present and past. Miami Geol. Soc. Mem. 2. 452 pp.

This paper describes nine of the more common peat types and their environments of deposition in southern Florida, including the coastal areas of ENP. They range from mangrove swamp and salt marsh peats, to brackish (transitional) swamp and marsh peats, to fresh water marsh and bay hammock peats. A guide is provided to identify the peats of the study area and, in particular, the peats of ENP. Differences in vegetational and depositional environments in which these sediments have been deposited have given them distinctive paleobotanical and petrographic compositions which are best detected by analyses of vertically oriented microtome sections.

Study Period:1964-1968; Study Type:Quantitative; Gear Type:Hand-operated, piston coring device; Number of Stations:20 core localities, several surface sites, mostly within ENP coastal areas; Habitat:Coastal mangrove swamp in ENP; Biological Component:Peats, *Rhizophora*, *Avicennia*, *Conocarpus*; Dominant Taxon/Taxa Studied:*R. mangle*, *A. nitida*, *Conocarpus*.

42. Cohen, A. D. and W. Spackman. 1977. Phytogenic organic sediments and sedimentary environments in the Everglades-Mangrove complex. Part II. The origin, description and classification of the peats of southern Florida. Palaeontographica Abt. B, Bd. 162. pg 72-114.

An investigation of the microscopic properties of peats in southern Florida was made in ENP by (1) using by using microtome thin sections to distinguish peat types, (2) to correlate each peat type with its modern environment of deposition; and (3) to determine the sequence of events associated with the transformation of peat to coal macerals. From 300 microtome sections of peat, 13 peat types were identified. Important conclusions useful in interpreting coal deposits of other ages include: the ratio of framework (coarse fraction) to matrix (fine fraction) for tree dominated, mangrove peats and non-aboral, dominated marine and fresh water peats; cell percentages are variable in marine autochthonous peats and high in fresh water peats; foraminiferal remains occurred in all marine and brackish peats; pollen & spores were more common in fresh water peats than in marine peats; pyrite was extremely variable in most all peat types.

Study Period:1964-1968; Study Type:Quantitative; Gear Type:Hand-operated, piston coring device; Number of Stations:20 core localities, several surface sites; Habitat:Coastal mangrove swamp; Biological Component:Peats (*Rhizophora, Avicennia, Conocarpus*); Dominant Taxon/Taxa Studied:*R. mangel, A. nitida, Conocarpus.*

43. Cohen, A. D. and W. Spackman. 1980. Phytogenic organic sediments and sedimentary environments in the Everglades Mangrove complex of Florida, Part III. The alteration of plant material in peats and the origin of coal macerals. Palaeontogr. Abt. B, Palaeophytol. 172(5-6):125-149.

Studies on the microtose sections of peats derived from extant plant species in the Everglades-mangrove region were conducted to determine the mode and degree of alteration of plant organs and tissues. Peatification of tissue from individual plant organs resembled its original composition and its incorporation into the peat deposit. Certain cells are altered in the direction of various bituminous coal macerals dependent upon their tissue color and structure with depth or age. With this information, a list of coal ingredients postulated to be derivatives of plant organ tissues is determined.

Study Period:1964-1968; Study Type:Qualitative; Habitat:Everglades-mangrove swamp; Biological Component:Flora; Dominant Taxon/Taxa Studied:*Rhizophora mangle, Maricus jamaicasis, Sagittaria lancifoila, Juncus roamanus, Spartina sp., Salix sp., Persea borbonia, Nymphaea odorata.*

44. Collins, L. A. and J. H. Finucane. 1984. Ichthyoplankton survey of the estuarine and inshore waters of the Florida Everglades, May 1971 to February 1972. NOAA Tech. Rept. NMFS 6, 75 pp.

Studies on the seasonal occurrence, abundance, and distribution of fish eggs and larvae were conducted in estuarine and inshore waters of the Florida Everglades (ENP) during 1971-72. Abundance of eggs and larvae was greatest in the inshore zone. The 10 most abundant fish families together made up 91% of all larvae and were in descending order of abundance: Clupeidae, Engraulidae, Gobiidae, Sciaenidae, Carangidae, Pomadasyidae, Cynoglossidae, Gerridae, Triglidae, and Soleidae. The inshore zone was a spawning ground and nursery for many important gamefish species. The authors suggest that salinity was one of several environmental factors that limited the numbers of eggs and larvae in the estuarine zone.

Study Period:May 1971-February 1972; Study Type:Quantitative; Habitat:Water column; Gear Type:1-M 505 mesh plankton net; Biological Component:Fish; Number of Stations:40 (20 in ENP); Temporal Frequency:Monthly; Abiotic Parameters Measured:Salinity, temperature, DO; Dominant Taxon/Taxa Studied:Clupeidae, Engraulidae, Gobiidae, Sciaenidae, Carangidae, Pomadasyidae, Cynoglossidae, Gerridae, Triglidae, and Soleidae.

45. Cooke, C. W. and S. Mossom. 1929. Geology of Florida. Fla. St. Geol. Surv., Twen. Ann. Rept., 1927-28. Tallahassee. Pgs. 29-228.

The geologic formations that make up the Floridian Plateau were named and described in this report. Additionally, the general features and local details for marine formations (Miami Oolite & Key Largo Limestone) underlying the coastal areas of ENP were discussed.

Study Type:Qualitative; Gear Type:Oil/well borings, surface outcrop observations.

46. Cooper, D. J. 1986. Variability in biogenic hydrogen sulfide emissions from selected Florida ecosystems. M.S. Thesis, Univ Miami, Coral Gables, Fla.

Hydrogen sulfide emissions were examined from several different habitats in Florida, characterizing swamps, tidal marshes, and natural water surfaces. Diel effects were found at all sites including Flamingo intertidal mudflats, mangrove swamp, and open water sea surface in Florida Bay in ENP. Water surface emissions peaked before dawn and had a broad minimum during the day. Tidal effects were more dramatic, and occurred for brief periods as water inundated the sampling site. The author presents an annual flux rate for Florida which is insignificant compared to the anthropogenic $SO_2$ flux, but because the highest $H_2S$ emissions are measured from specific plant communities (mangroves & tidal marshes), the natural input to the atmosphere may be important on a smaller scale.

Study Period:March-October 1985; Study Type:Quantitative; Habitat:Coastal mangrove swamp, tidal flats, open water in ENP; Number of Stations:3-In ENP; Abiotic Parameters Measured:Air temp., wind speed & direction, humidity, solar flux, $H_2S$.

47. Cooper, W. J. 1971. Geochemistry of lipid components in peat-forming environments of the Florida Everglades. M.S. Thesis. The Pennsylvania State Univ., University Park, Pa. 258 pp.

The objectives of this research were to obtain a phenomenological description of the fate of lipid components in certain higher plants as the plant parts decay and become incorporated into peat; to determine what components may be added from other sources; and to use the information to further understand processes of peat accumulations. Accordingly, the distribution of hydrocarbons and fatty acids in *Rhizophora mangle*, *Mariscus* and *Nymphaea* and in surface litter and peats derived from these plants were determined. Sites sampled in ENP included Little Shark River and Rookery Branch of the Shark River. It was established that in the transition, fresh plant - surface litter - peat, the cuticular components largely outweigh the intracellular; that is the latter are removed during decay and peat accumulation.

Study Period:Summer 1967; Study Type:Quantitative; Habitat:Coastal mangrove swamp in ENP; Gear Type:Cores; Number of Stations:4 (2 in ENP); Temporal Frequency:Once; Dominant Taxon/Taxa Studied:*Rhizophora mangle*.

48. Costello, T. J., D. M. Allen and J. H. Hudson. 1986. Distribution, seasonal abundance, and ecology of juvenile northern pink shrimp, *Penaeus duorarum*, in the Florida Bay area. NOAA Technical Memo. NMFS-SEFC-161. Miami, Fla. 84 pp.

Studies on the distribution, seasonal abundance, and ecology of the pink shrimp, *Penaeus duorarum*, were made in the shallow waters of Florida Bay mainly within ENP from 1965-1968. Maximum concentrations of early juveniles were in the western Bay; few occurred in the eastern Bay. Juveniles occurred year-round and were most abundant from summer to winter in grassbeds. Movement and distribution in the Bay is based on flooding tide and the rise in sea level. Sea level variations may also control their nearshore abundance and subsequent production on the offshore fishing grounds. Authors suggest that postlarvae seek out areas of shoal grass, *Halodule wrightii*, for initial benthic settling.Optimal habitat is defined as relatively open marine water circulation with daily tidal exchange and broad intertidal or subtidal beds of shoal grass with high blade densities. Shoal grass may be a critical factor in recruitment success.

Study Period:1965-1968 (salinities measured 1967-1969); Study Type:Qualitative, quantitative; Habitat;seagrass; Gear Type:Suction dredge (preliminary studies), benthic sled net; Number of Stations:22 (regular); Number of Replicates/ Station:1-2 (sled net); Temporal Frequency:Monthly; Abiotic Parameters Measured: Salinity, temperature, turbidity, bottom type; Biological Component:Flora and Fauna; Dominant Taxon/Taxa Studied:*Penaeus duorarum*.

49. Costello, T. J. and D. M. Allen. 1969. Ecology of pink shrimp in Florida Bay. IN: M.J. Lindner and R.E. Stevenson (eds), Report of the Bureau of Commercial Fisheries Biological Laboratory, Galveston, Texas, fiscal year 1968, p. 9-10, U.S. Fish Wildl. Serv., Circ. 325.

Studies in Florida Bay have produced a variety of ecological information on young pink shrimp, *Penarus duorarum*, not previously available. The Florida Bay portion of ENP is prime nursery area for shrimp of the Tortugas fishery. Postlarvae enter Florida Bay through the Florida Keys and settle out in greatest numbers near shoalgrass shoreline. Quantitative samples of postlarvae at Whale Harbor Channel recorded seasonal peaks in spring, summer, and fall. Shrimp densities continue to vary according to Florida Bay water circulation patterns. Highest densities are in western Florida Bay, moderate densities in central Bay, and small numbers occur in restricted areas of water circulation in NE Florida Bay.

Study Period:1965-1968; Study Type:Quantitative; Habitat:Water column (postlarvae), Grassbeds (juveniles); Number of Stations:22; Temporal Frequency: monthly; Biological Component:Flora and fauna; Dominant Taxon/Taxa Studied: *Penaeus duorarum*.

50. Costello, T. J. and D. M. Allen. 1966. Florida Bay ecology project. Annual Report of the Bureau of Commercial Fisheries Biological Laboratory, Galveston, Texas, fiscal year 1965, p. 15-18, (eds): J. Lindner and J.H. Kutkuhn. U.S. Fish and Wild. Serv., Circ. 246.

Studies on juvenile pink shrimp populations began in 1964 to establish a quantitative index of abundance, describe the habitat types of shrimp inhabitating eastern Florida Bay and relate to juvenile density. Development of various sampling methods and procedures are described for beam trawls, chemical repellents, and suction dredge. Preliminary results indicate densities of small shrimp in eastern Florida Bay are low when compared to similar samples from Biscayne Bay.

Study Period:1964-1965; Study Type:Quantitative; Gear Types:Trawls, chemical repellents, suction dredge; Biological Component:Benthic fauna;Dominant Taxon/Taxa:*Penaeus duorarum.*

51. Costello, T. J. and D. M. Allen. 1967. Florida Bay ecology project. IN: M.J. Lindner and R.E. Stevenson (eds), Report of the Bureau of Commercial Fisheries Biological Laboratory, Galveston, Texas, fiscal year 1966, p. 9-11. U.S. Fish and Wildl. Serv. Circ. 268.

The first year of a on-going benthic ecology study on post larval and juvenile pink shrimp in eastern Florida Bay was completed. Variations in abundance of postlarvae collected at Whale Harbor Channel and other Keys bridges by plankton nets were compared to juvenile shrimp densities on the nursery grounds. Associated organisms collected in suction dredge samples were used to determine habitat types preferred by pink shrimp. Peaks of abundance for small shrimp and associated organisms appeared in August and November and followed postlarvae abundance peaks on bridge sites by one month.

Study Period:1965-1966; Study Type:Quantitative; Habitat:Water column and grassbeds; Gear Types:Plankton nets and suction dredge; Number of Stations:11; Biological Component:Benthic fauna; Abiotic Parameters Measured:Salinity, temperature, current velocity; Dominant Taxon/Taxa Studied:*Penaeus duorarum.*

52. Costello, T. J. and D. M. Allen. 1968. Florida Bay ecology studies. IN: M.J. Lindner and R.E. Stevenson (eds), Report of the Bureau of Commercial Fisheries Biological Laboratory, Galveston, Texas, fiscal year 1967, p. 10-12., U.S. Fish and Wildl. Serv., Circ. 295.

Two years of studies on postlarval and juvenile pink shrimp in the Florida Bay area have been completed. Postlarval recruitment continues year-round at Whale Harbor Channel. Monthly sampling for juveniles has been expanded with a marsh (sled) net to 22 widely distributed shallow-water sites. Juvenile distribution depends upon the degree of postlarval penetration in the estuary. Maximum concentrations of juveniles occurs in western Florida Bay which receives large volumes of water from tidal exchange, conversely NE Florida Bay which receives little water flow from these sources contains few early juveniles. The feasibility of introducing artificially reared young shrimp in shrimp deficient areas to increase production was investigated.

Study Period:1965-1967; Study Type:Quantitative; Habitat:Water column and grassbeds; Number of Stations:22; Temporal Frequency:Monthly; Biological Component:Flora and fauna; Dominant Taxon/Taxa:*Penaeus duorarum.*

53. Costello, T. J. and D. M. Allen. 1959. Migration and growth of pink shrimp. Galveston biological Laboratory, fishery research for the year ending June 30, 1959. U.S. Dept of Inter., Fish and Wildl. Serv., Circ. No. 62. pp. 13-18.

Studies on pink shrimp, *Penaeus duorarum*, which support a valuable fisheries on the Tortugas in the Gulf of Mexico were conducted to delineate the nearshore nursery grounds by using three mark-recovery experiments on juveniles in the nearshore waters of Florida Bay (ENP). Recaptures on the offshore fisheries grounds indicate the importance of the shallow waters of Florida Bay as a nursery area for the heavily exploited Tortugas pink shrimp fishery. The number of recoveries were too few to accurately determine growth.

Study Period:October 1958-March 1959; Study Type:Semi-quantitative; Habitat: Grassbeds; Biological Component:Shrimp; Gear Type:Trawl; Dominant Taxon/Taxa: *Penaeus duorarum*.

54. Costello, T. J. and D. M. Allen. 1961. Migrations, and mortality, and growth of pink shrimp. IN: Galveston Biological Laboratory, fishery research for the year ending June 30, 1961. U.S. Dept. of Interior, Fish and Wildl. Serv., Circ. No. 129. pp. 18-21.

No abstract available.

55. Costello, T. J. and D. M. Allen. 1966. Migrations and geographic distribution of pink shrimp, *Penaeus duorarum* of the Tortugas and Sanibel Grounds, Florida. U.S. Fish and Wildl. Serv., Fish Bull. 65:449-459.

The pink shrimp, *Penaeus duorarum*, populations of south Florida's nearshore and offshore waters were investigated from 1958-1963. Fifteen mark-recovery experiments (five within ENP) demonstrated the importance of certain shallow coastal waters as nursery areas for pink shrimp that eventually frequent the offshore Tortugas and Sanibel Grounds. Shrimp may spend 2-6 months in the nursery, have broad migration routes, and travel at least 150 miles before recovery on the offshore grounds. The Tortugas shrimp nursery grounds include Florida Bay as far north as Indian Key thus a large portion of the estuarine nursery is located in ENP. Nursery areas of the Sanibel shrimp stocks includes estuaries from Indian Key northward to Pine Island Sound. Both offshore shrimp stocks overlap inshore near Indian Key and offshore between the two trawling grounds. Only minimum ranges of the offshore shrimp stocks are presented.

Study Period:April 1958-March 1963; Study Type:Semi-quantitative; Biological Component:Penaeid Shrimp; Habitat:variable; Gear Type:Trawl; Number of Stations:15; Dominant Taxon/Taxa Studied:*Penaeus duorarum*.

56. Costello, T. J. and D. M. Allen. 1961. Notes on the migration and growth of pink shrimp, (*Penaeus duorarum*). Proc. Gulf and Carib. Fish. Inst. 12:5-9.

Pink shrimp which occur in nearshore waters of south Florida as juveniles and as adults on the offshore Tortugas Grounds, were investigated using three mark-recovery experiments in Florida Bay (ENP). Fifteen verified recoveries from

shrimp marked at Flamingo and Peterson Keys serve as a first step in delineating the estuarine nursery areas which contribute to the maintenance of the Tortugas shrimp population.

Study Period:October 1958-March 1959; Study Type:Biological; Habitat:Grassbeds; Biological Component:Shrimp; Gear Type:Trawl;Dominant Taxon/Taxa:*Penaeus duorarum*.

57. Costello, T. J. and D. M. Allen. 1965. Pink shrimp life history. IN: M. J. Lindner and J.H. Kutkuhn (eds), Biological Laboratory, Galveston, Tex., fishery research for the year ending June 30 1964, p. 22-24., U.S. Fish and Wildl. Serv., Circ. 230.

No abstract available.

58. Costello, T. J. and D. M. Allen. 1970. Synopsis of biological data on pink shrimp, *Penaeus duorarum*, Burkenroad, 1969. FAO Fish. Rep. No. 57, Vol. 4, 1499-1537.

A review and summary of biological and ecological information on pink shrimp is presented from studies conducted mostly in the Gulf of Mexico and adjacent waters including ENP estuaries.

Study Type:Biological review; Dominant Taxon/Taxa Studied:Pink shrimp, *Penaeus duorarum*.

59. Cottrell, D. J. 1989. Holocene evolution of the northeastern coast and islands of Florida Bay. Bull. Mar. Sci. (Abstract). 44:516.

The comparative stratigraphy of the mainland coast and islands of northeastern Florida Bay (ENP) shows that both the islands and the present coastline initiated from paralic shoreline deposits during an earlier stage of Holocene sea level rise. The present mainland coast is composed of 1.5 to 2 m of Holocene sediment over a shallowly submerged, Pleistocene limestone surface. This build-up initiated from paralic peats and muds from which evolved two basic coastal features; an east-west trending coastal levee and several narrow, north-south trending peninsulas extending into Florida Bay. The coastal levee is characterized by basal paralic swamp and marsh sediments overlain by supratidal levee muds. These levee mud deposits represent stable, continuous shoreline development during the past few thousand years. Peninsulas, however, have resulted from supratidal sediments accreting over subtidal mud build-ups. Peninsulas have, at their base of their windward margins, a westward-thinning wedge of paralic peat or marsh sediment. This wedge is interpreted as a remnant of the basal paralic deposit from which the peninsulas was initiated. Windward shore erosion and leeward progradation have caused peninsulas to migrate westward across leeside subtidal deposits.-Adapted from author's abstract.

60. Craighead, F. C., Sr. 1964. Land, mangroves, and hurricanes. Fairchild Trop. Gard. Bull. (Miami, Fla.) 19(4):1-28.

Observations on the land building up in the mangrove zone within ENP from deposits of soil suggests that it has increased at a rapid rate since the last major ice age from accumulations of marine algae in Florida Bay and the southward movement of freshwater algae in the Everglades. Water surfaces, constricted by red mangroves followed by marl and peat deposits led to the development of Florida Bay Keys and the mangrove belt. A review of the geology of the mangrove belt is presented.

Study Type:Qualitative, review; Habitat:Mangrove swamp.

61. Craighead, F. C., Sr. and V. D. Gilbert. 1962. The effects of Hurricane Donna on the vegetation of southern Florida. Q. J. Fla. Acad. Sci. 25(1-28.)

A hurricane on September 10, 1960, caused extensive damage to the vegetation and effected many physical changes in the soil and local topography of southern Florida, particularly within ENP. Observations by the authors covered the mangrove belt, Florida Bay Keys, Ten Thousand Islands, Cape Sable, Pinelands, Open Everglades, and Hammocks. Greatest destruction of trees occurred in the mangrove belt near Flamingo and on the Keys in western Florida Bay. Most severe damage was from Maderia Bay to Shark River. Southeastern portions of Florida Bay Keys were damaged most severely from defoliation and breakage. Several species of trees were more resistent to wind damage than others. Other causes of mangrove mortality discussed included bruising, destruction of the phloem and root system, and lack of oxygen. Observations on coastal silt deposits, Cape Sable dune ridges, and obliteration of smaller Keys are presented.

Study Type:Qualitative; Habitat:Coastal mangrove swamp, keys.

62. Crapon de Caprona, A. 1978. Foraminiferes et microfaunes associees de l'ilot de Murray Key, Baie de Floride (Foraminifera and associated microfauna of Muurray Key, Florida Bay). Univ. Geneve, Lab. Paleontol., Geneva. Notes du Laboratoire de Paleontologie 2(1-13):37-43 (In French).

No abstract available.

63. Croker, R. A. 1960. A contribution to the life history of the gray (mangrove) snapper, *Lutjanus griseus* (Linnaeus). M.S. Thesis. Univ. of Miami, Miami, Fla. 93 pp.

The biology of gray snapper, *Lutjanus griseus*, in ENP was studied from 1959-1960. Based on 849 fish collected mainly from the ENP sportfishery, snapper ranged in age from 1-5 years with age groups I and II making up 62 and 29% of the catch. Mean lengths, age and length at recruitment, length-weight relationship,and sex ratio were determined. Data are presented concerning habitat, and salinity and temperature ranges including cold water induced mortality. Stomach contents of 200 snapper indicated Crustacea dominated by frequency and volume with shrimp occurring most frequently. Fish and crabs were the second and third most important food groups by frequency.

Study Period:April 1959-April 1960; Habitat:Coastal mangrove, estuarine bays, and lagoons; Study Type:Semi-quantitative and quantitative; Biological Component:Fish; Gear Type:Hook & Line, Trawl; Temporal Frequency:Monthly; Abiotic Parameters Measured:Salinity, temperature; Dominant Taxon/Taxa Studied:*Lutjanus griseus*.

64. Croker, R. A. 1962. Growth and food of the gray snapper, *Lutjanus griseus* in Everglades National Park. Trans. Amer. Fish Soc. 91(4):379-383.

The biology of gray snapper, *Lutjanus griseus*, was studied in ENP during the period 1969-1960. Based on 849 fish collected mainly from the ENP sportfishery, snapper ranged in age from 1-5 years with age groups I and II making up 62 and 29% of the catch. Mean lengths and length at recruitment into the sportfishery, length-weight relationship, and sex ratio of gray snapper are given. All ENP fish were immature. Stomach contents of 200 specimens indicated Crustacea dominated by frequency and volume with shrimp occurring most frequently while fish and crabs were the second and third most important food groups by frequency.

Study Period:April 1959 to April 1960; Habitat:estuarine and coastal marine; Study Type:Semi-quantitative;Biological Component:fish; Temporal Frequency:Monthly; Gear Type:hook & Line; Dominant Taxon/Taxa Studied:*Lutjanus griseus*.

65. Daley, R. J. 1970. Systematics of southern Florida anchovies (Pisces:Engraulidae). Bull. Mar. Sci. 20(1):70-104.

Samples of southern Florida anchovies were collected around the southern end of the Florida peninsula including ENP and were used to analyze variation in gill rakers, vertebrae, and fin rays. Most of the specimens identified belonged to the following five species: *Anchoa lamprotaenia*, *A. hepsetus*, *A. nasuta*, *A. mitchilli*, and *Anchoviella perfasciata*. An identification key is given based on meristic and proportional characters and pigmentation. Observations on their relative abundance and distribution around the tip of Florida are presented.

Study Period:1964-1965; Habitat:variable; Study Type:Qualitative; Dominant Taxon/Taxa Studied:*A. lamprotaenia*, *A. hepsetus*, *A. nasuta*, *A. mitchilli*, *Anchoviella perfasciata*.

66. Davies, T. D. 1979. The carbonaceous sediments of Florida Bay and their anomalous sulfur content, pg. 49. In Abstracts of Papers, IX Inter. Congr. of Carbon. Strat. and Geol., May 1979, Urbana, Il.

No abstract available.

67. Davies, T. D. 1980. Peat formation in Florida Bay and its significance in interpreting the recent vegetational and geological history of the bay area. Ph.D. Dissert., The Pennsylvania State Univ., University Park, PA. 338 pp.

This investigation was conducted to develop an understanding of vegetational and geological history of Florida Bay and to relate the Bay's history to the development

and/or destruction of the south Florida seacoast. It was determined that peat is more widespread over the Bay than previously recorded, peat commonly occurs as basal sediment beneath islands/banks, and peat sedimentation began approximately 5,500 years ago in the southwest portion of the Bay. Thirteen peat types were identified. Results also indicated that foraminiferal remains are common in marine peats; plant fragments, palynomorphs, charcoal, sponge spicules, foram remains and radiolaria are useful in paleoenvironmental reconstruction; and that the sedimentary cycle of Florida Bay consisting of a transgressive sequence includes, beginning at the base: (a) freshwater carbonate mud, (b) freshwater marsh & swamp peat, (c) brackish water peat, and (d) marine peat.

Study Period:June - August 1972; Study Type:Quantitative/qualitative; Gear Type:Nautical Chart (1250), alum. rod, Davis sampler, probes, piston coring device; Number of Stations:621; Number of Replicates/Station:1-2; Habitat:Island, bank, basin, swamp, marsh, bedrock; Abiotic Parameters Measured:Water temperature, salinity, conductivity, mineralogy, water & sediment depth, peat thickness, sediment characteristics, depth to bedrock; Biological Component:Flora & fauna; Dominant Taxon/Taxa Studied:*Rhizophora, Avicennia, Sagittaria, Conocarpus.*

68. Davies, T. D. 1979. The use of peat petrography in reconstructing shoreline migration in the area of Florida Bay. Geol. Soc. Am. Abstr. Prog. 11(7):410.

This study substantiates the hypothesis set forth by Scholl and Stuvier (1967, reference no. 365 in bibliography) and Scholl et al., (1969, no. 363) that sea level rise in Florida Bay, to its present level, has been continuous during the last 5,500 radiocarbon years. It was found that 13 peat types occur in Florida Bay, ranging from freshwater to marine. Radiocarbon dates of the basal freshwater peats suggest that sedimentation of the freshwater peats took place in the southwestern part of the Bay prior to 5,000 Before Present. The sea probably did not begin to influence the vegetation of the Bay until sometime after 5,000 years ago as shown by the freshwater tree island peat underlying Ninemile Bank (dated to be 5190 $\pm$ 100 yrs BP). It was determined that the shoreline initiated its migration into the Bay area later than previously recognized and its eastern movement has been slower than heretofore thought.-Adapted from author's abstract.

69. Davies, T. D. and W. Spackman. 1978. The nature, occurrence, and significance of peat in Florida Bay. Geol. Soc. Am., Abstr. Progr. 10(7):386.

The sporadic occurrence of a buried peat layer has been reported by most researchers concerned with the sediments of Florida Bay (ENP). However, sampling on a one-mile square grid pattern has revealed the presence of a sub-marl autochthonous peat over a much larger area than previously shown. Eleven peat cores from "islands" and "banks" immediately south of the Florida mainland in ENP were analyzed petrographically, palynologically, and chemically and showed that terrestrial vegetation occupied a large portion of the Bay in the recent past. Basal peat sediments indicate that much of the area involved was covered with freshwater marsh and swamp environments with the saline mangrove environment which now characterizes the Bay gradually encroaching from the south and west. The environments associated with freshwater peats including

water-lily, saw grass-arrowhead and buttonbush peats, became progressively more saline and are overlain by brackish buttonwood peat, which is, in turn, overlain by saline mangrove peat. The transgressive sequence is completed by several feet of carbonate mud. The now discontinuous occurrences of peat may have been continuous with peat layers of the mainland. The low pyrite and sulfur concentrations in peats may have been due to the lack of available iron.-Adapted from authors' abstract.

70. Davies, T. D. and W. Spackman. 1980. The palynology of the peats of Florida Bay. Palynology 4:238. (Abs.).

No abstract available.

71. Davis, C. C. 1949. Observations of plankton taken in marine waters of Florida in 1947 and 1948. Quart. J. Fla. Acad. Sci. 12(2):67-103.

This is a report on the results to date of a series of exploratory collections taken at widely scattered locations on both coasts of Florida, including Florida Bay (ENP), to provide a preliminary taxonomic assessment on the plankton of the region investigated. The waters of upper Florida Bay (West Lake, Long & Blackwater Sounds) were similar to those of the inland waters of the lower east coast in that the plankton was relatively sparse.

Study Period:January - October 1947; Study Type:Qualitative; Habitat:Inland & coastal waters; Gear Type:Plankton nets; Number of Stations:Variable,(6 in ENP); Biological Component:Flora & fauna; Dominant Taxon/Taxa Studied:Diatoms, copepods (*Acartia, Paracalanus*).

72. Davis, C. C. and R. H. Williams. 1950. Brackish water plankton of mangrove areas in southern Florida. Ecology 31(4):519-531.

Thirty-nine plankton samples from 28 stations in the mangrove areas of the Ten Thousand Islands and northern Florida Bay (ENP) and Barnes Sound were collected during the first half of 1948 and June 1947. Salinities are presented on dates of collection. Differences in plankton composition were probably related to local salinity differences.

Study Period:1947-1948; Habitat:Mangrove swamp; Study Type:Qualitative; Biological Component:Plankton; Gear Type;Plankton Nets; Number of Stations:28; Number of Replicates/Station:1; Temporal Frequency:irregular/monthly; Abiotic Parameters Measured:Salinity; Dominant Taxon/Taxa Studied:Copepod nauplii, pelecypod veligers, *Anura* sp., *Acartia* sp.

73. Davis, G. E. 1979. An assessment of fishery management options in Everglades National Park, Florida. Rept. T-541. Homestead, Fla., Everglades N.P., South Florida Research Center.

This report presents an assessment which considers the biological and socio-economic impacts of several alternative fishery management actions for ENP.

The ultimate goal of this process is to provide the information upon which decisions can be made to produce regulations to effectively manage park fisheries in accordance with existing guidelines. Fish mortality must be compensated by natural reproduction and commercial and recreational fishing will be managed to maintain traditional age and size structure of fish populations. A conflict between both fisheries has intensified concerning the use of nets and unlimited harvest of gamefish species in the park. Alternative management options include prohibition of net fishing in all or certain parts of Florida Bay; establish specific bag limits for red drum, snook, sea trout, and gray snapper and/or a combination of species; prohibit harvest of lobster, stone crab and limit or restructure commercial fishing permits; limit powerboat use and prohibit snook harvest in summer. Major socio-economic positive and negative impacts are given for each option.

Study Type:Qualitative, fishery management review.

74. Davis, G. E. 1980. Changes in the Everglades National Park red drum and spotted seatrout fisheries, 1958-1978. Fishing pressure, environmental stress or natural cycles ? IN: Proc. Coll. on the Biology and management of red drum and seatrout, 81-87., Gulf States Mar. Fish. Comm.

An evaluation of the recreational and commercial fisheries for red drum and spotted seatrout in ENP during the period of 1958-1978 was presented. Three significant changes have occurred in these park fisheries: (1) A shift in age structure towards larger, mature fish; (2) increase in catch rates for red drum (24 to 127%) and decreased for spotted seatrout (6-54%); and (3) marked reductions in the year to year variability of catch rates for both species. It was suggested by the author that changes in environmental conditions in park estuaries were responsible for changes in fishery stocks and nature of harvest.

Study Period:1958-1978; Habitat:estuarine and coastal marine; Biological Component:sport and commercial fish; Study Type:Creel census (Biological); Abiotic Parameters Measured:Salinity, Temperature; Dominant Taxon/Taxa Studied:Red drum, snook, spotted seatrout, gray snapper.

75. Davis, G. E. 1980. Juvenile spiny lobster management or how to make the most of what you get. Fisheries 5(2):57-62.

Larval production and survival, equitable allocation and efficient harvest among fishermen, and maximization of yield per postlarval recruit are identified as the major elements amenable to management actions in spiny lobster fisheries. A step down diagram is provided which illustrates the logical relationship among the three elements, the overall fishery objective of an optimum yield and a description of the relationship between the factors involved in improving the yield per postlarval recruit. The factors discussed in the paper are: minimum harvest size, growth values, mortality rates and nursery sanctuaries. National Parks' provide protection for about 1/3 of the juvenile spiny lobster habitat in south Florida.

Study Type:Management review; Biological Component:Decapod crustacea; Dominant Taxon/Taxa Studied:Spiny lobster, *Panulrius argus*.

76. Davis, G. E. 1981. On the role of underwater parks and sanctuaries in the management of coastal resources in the southeastern United States. Environmental Conser. 8(1):67-70.

This paper reviews the role of underwater parks, including ENP, and sanctuaries in the management of coastal resources in the southeastern United States. Aquatic resources in parks and reserves are not as adequately protected as comparable terrestrial resources. Thus reservoirs of genetic materials are apt to be greatly diminished. Dynamic ecosystems such as a coral reefs require protected natural areas to permit distinctions to be drawn between the effects of exploitation or pollution and normal variation. Fisheries harvest may reduce the size at which exploited species mature and reduce the amount and variability of genetic material produced by exploited populations. The seven underwater parks or reserves established since 1935 in Florida and the U.S. Virgin Islands exhibit wide variation in the degree of protection ranging from nearly complete protection in the first parks to virtually no protection in the recent parks. The author suggests that unless consumptive uses are curtailed the principal values of parks may never be realized.

Study Type:Review; Habitat:Estuarine and marine.

77. Davis, G. E. 1980. Recreational and commercial fisheries in Everglades National Park: an ecosystem approach to resource management. p. 228-256. IN: Proc. Second Conf. on Scientific Research in National Parks, Nov. 1979, San Fran., Calif. NTIS Report No. NPS/ST-80/02-7.

Information on the management of fishery resources in ENP is presented. Both commercial and recreational fishermen are involved with over 20 commonly harvested species. Analysis of catch data, fishing effort, population age structure of exploited species, boating activity and environmental conditions ranging from 1958-1978 is discussed. It was deduced that some species increased in abundance with changes in population age structure while others declined in abundance with no changes in age structure. Increases in boating activity were associated with declines in catch rates whereas decreases in boating activity resulted in increases in catch rates. The author hypothesizes that the decline of major gamefish species may have been related to extreme climatic events and/or watershed activities. No effects of harvest on finfish stocks in the park were detected.

Study Type:Creel census survey; Habitat;Estuarine and marine; Study Period:1958-1978; Biological Component:Finfish and shellfish; Dominant Taxon/Taxa studied:Red drum, seatrout, gray snapper, snook, stone crab; Abiotic Parameters Measured:Salinity, temperature.

78. Davis, G. E., D. S. Baughman, J. D. Chapman, D. MacArthur and A. H. Pierce. 1978. Mortality associated with declawing stone crabs, *Menippe mercenaria*. Report T-522. Homestead, Fla., Everglades N.P., South Florida Research Center. 23 pp.

This study was designed to measure the mortality of declawing stone crabs, *Menippe mercenaria*, using standard commercial techniques under laboratory conditions, as a precursor to a field investigation. From 1977 to 1978, 201 stone crabs were collected by traps in Florida Bay, returned to the lab and maintained in aquaria. Of 101 crabs that had both claws removed, 47 died and 28 of 100 single claw amputees died. Declawing wound width was significantly correlated with survival. Instantaneous crab mortality from declawing wounds of commercial fishermen ranged from 23 to 51%.

Study Period:April 1977-March 1978; Study Type:Quantitative; Biological Component:Decapod crustacean (crab); Gear Type:Traps; Abiotic Parameters Measured:(In Lab), Salinity, temperature, DO, nitrates; Dominant Taxon/Taxa Studied:*Menippe mercenaria*.

79. Davis, G. E. and J. W. Dodrill. 1980. Marine parks and sanctuaries for spiny lobster fisheries management. Proc. Gulf Carib, Fish. Inst. 32:194-207.

Studies on spiny lobster were conducted in south Florida coastal waters managed by the NPS and in the Virgin Islands. Recreational harvest and food habits was examined in FOJE. Distributional, abundance, and migrational studies were conducted in BNP and ENP while ecological and fisheries studies were conducted in VINP.During these studies 14,119 lobsters were tagged and another 5961 were measured and examined. Information on sizes, numbers,locations of recaptures is summarized. Growth rates varied by sex at FOJE but not at BNP or ENP. High incidence of injuries may have affected growth in BNP and FOJE. Mean growth rate (40 mm CL/year) of juveniles in Florida Bay was much higher than observed elsewhere. Data on reproductive activity in FOJE and BNP is discussed along with lack of movement in FOJE by adults while juveniles of BNP and ENP displayed long range patterns of movement. BNP and ENP serve as nursery areas for the entire Florida fishery. The benefits of examining an undisturbed natural population for comparison with an exploited system is examined through regional reproductive and genetic reserves along with educational opportunities and recreational use.

Study Period:1969-1979; Habitat:mud, sand, shell, coral, rock, grassbeds; Study Type:semi-quantitative; Biological Component; Decapod crustacean; Gear Types:Hand, bully net, trawl, snare, traps; Temporal Frequency:weekly/monthly; Dominant Taxon/Taxa Studied:*Panulirus argus*.

80. Davis, G. E., J. W. Dodrill and J. T. Tilmant. 1989. The recreational fishery and population dynamics of spiny lobster, *Panulirus argus*, in Florida Bay, Everglades National Park, 1977-1980. Bull Mar Sci. 44:78-88.

The population dynamics and recreational fishery of spiny lobster, *Panulirus argus*, was studied within the Florida Bay portion of ENP from 1977 to 1980. Juvenile and adult lobsters were captured at seven sites by hand, trap, and snare. Data are presented on length, reproductive condition, and injuries; lobsters larger than 35 mm CL were tagged. Based on field studies of 3570 tagged specimens, lobsters pass through Florida Bay using it for approximately three years as juveniles and support commercial and recreational fisheries outside of ENP from Dry Tortugas to Miami. Growth rates of juveniles are the highest on record and suggested to be due to optimum habitat with abundant food and shelter. It was found that the

recreational fishery harvested about 20,000 and 44,000 lobsters during the 78-79 and 79-80 seasons, respectively. In 1980 a nursery sanctuary was established in the Florida Bay portion of ENP.

Study Period:1977-1980; Study Type:Semi-quantitative; Habitat:Grassbeds, sand, mud, rock, coral; Biological Component:Decapod crustacea; Number of Stations:7; Temporal Frequency:Monthly; Abiotic Parameters Measured:Salinity, temperature, turbidity; Gear Types:Hand, snare, trap, trawl; Dominant Taxon/Taxa Studied: *Panulirus argus*.

81. Davis, G. E. and C. A. Hilsenbeck. 1974. The effects of watershed management on the Shark Slough Whitewater Bay estuary of Everglades National Park, Florida. Final Report RSP-EVER-N-65. Everglades National Park. 16 pp.

A study on the effects of upstream environmental conditions on the epibenthic community structure in the Whitewater Bay Shark River estuary of ENP was conducted during 1973-1974. It was found that runoff, as it effected water levels in the water shed and the reduction of annual rainfall and increase in saltwater intrusion from Florida Bay determined the seasonality and magnitude of salinity flux in the estuary, resulting in the replacement of the estuarine nursery area by a coastal marine system. The authors suggest that although the system will remain productive , its loss will cause reduction of fisheries as supported by larval recruitment. Salinity and substrate significantly affected the amount of total benthic biomass. Authors suggest salinity most important since substrate does not change seasonally.

Study Period:October 1973-September 1974; Habitat:Open/enclosed bays of mud, sand, shell, rock, grassbeds; Study Type:semi-quantitative, quantitative; Biological Component:Macroinvertebrates, fish, marine algae, seagrass; Gear Type:grab sampler, otter trawl, creel census; Number of Stations:5 (biological), 26 (hydrological); Number of Replicates/Station:2-10; Temporal Frequency:monthly/ quarterly; Abiotic Parameters Measured:Salinity, air and water, temperature, DO, pH, turbidity, wind speed and direction, rainfall, water discharge and water levels in the watershed; Dominant Taxon/Taxa Studied:Mollusca, crustacea, marine algae (*Udotea, Sargassum*), seagrass (Halodule), and fish (Bay anchovy, pinfish, silver jenny, pigfish) pink shrimp.

82. Davis, G. E. and E. B. Thue. 1979. Fishery data management handbook, Everglades National Park. Rept. T-546. Homestead, Fla., Everglades N.P., South Florida Research Center.

A data acquisition and summary program for monitoring the fishery resources in Everglades National Park is described. The sources of catch and fishing effort data are given along with procedures for estimating boating and fishing activity in the park. Instructions for collection of data and utilization of the NPS computer facilities for the generation of annual and quarterly reports are provided. The content and format of these catch reports are described and examples provided.

Study Type:Handbook.

83. Davis, G. E. and M. C. Whiting. 1977. Loggerhead sea turtle nesting in Everglades National Park, Florida, USA. Herptologica 33:18-28.

A review was made of 10 years of studies on sea turtle nesting along the coastline of ENP (mainly the Cape Sable region). Virtually all nesting was by loggerhead turtles, *Caretta caretta*. Nesting activity increased from approximately 455 nests to 915 nests per nesting season from 1964-65 to 1972-73. Two times as much nesting activity occurred in even numbered years than in the following odd numbered years. For the period 1972-73, data are reported concerning location date of tagging, nest activity and the tags used. Nesting interval, clutch size, and decline within a season along with population trends and predation by racoons are discussed. Management recommendation also were given.

Study Period:1964-1973; Study Type:Semi-quantitative; Habitat:Marl-sand shell beach; Biological Component:Sea Turtles; Temporal Frequency:5-10 day intervals, May to August (1972-73); Dominant Taxon/Taxa Studied:*Caretta Caretta*.

84. Davis, J. H. 1940. The ecology and geologic role of mangroves in Florida. Carnegie Inst. Wash., Publ. 517, Pap. Tortugas Lab. 32:305-412.

The mangrove swamps of five coastal regions in southern Florida, mainly within the boundaries of ENP, were studied during five seasons from 1936 to 1938. The report is divided into 2 parts : (1) The ecology of mangroves deals with mangrove communities and associated vegetation, succession, zonation, major environmental factors, and seed dispersal, (2) The geology of mangroves is discussed including soil profiles, deposition, and geologic history of the region. Important external environmental factors described are salinity, soil, tides, water level, and temperature. Three main types of soils, peat and muck, marl, and sands are discussed. Land area build-up from sediment trapped by mangrove roots and extended coastal soils are examined as related to sea-level change and peat deposits.

Study Period:1936-1938; Study Type:Qualitative; Habitat:Mangrove swamp (sand, mud, peat, shell); Biological Component:Mangroves and associated vegetation; Abiotic Parameters Measured:Salinity, tides, water levels, evaporation, air temperature.

85. Davis, J. H. 1943. The natural features of southern Florida, especially the vegetation and the Everglades. Fla. Geol. Surv. Bull. 25:1-311.

The purpose of this survey and description is to provide a better understanding of the natural features (climate, swamps, marshes) of southern Florida and to offer suggestions for their proper use. Other important conditions to consider are the interrelationships of these natural features, for example, it is difficult to understand the Everglades, which is the most important part of this description, and plan for its future without knowing the way this marsh and swamp were formed, which involves knowledge of the geologic history, soil, vegetation, and climate, as well as the topography and drainage conditions. Approximately 13000 sq mi were surveyed, from Highlands to Monroe County, over a two year period. The emphasis of this study was on plant ecology; the distribution of vegetation was mapped, including the coastal mangrove swamp of ENP and ecological

considerations of the vegetation are provided. Additionally, a discussion of fish & wildlife in the Everglades coastal area was given along with comments on the impact of the increased use of agriculture on the slough and adjacent coastal areas.

Study Period:1941-43; Study Type:Qualitative; Habitat:Variable; Biological Component:Flora & fauna.

86. DeBellevue, E., H. T. Odum, J. Browder and G. Gardner. 1978. Energy analysis of the Everglades National Park. Report T-527. Homestead, Fla., Everglades N.P., South Florida Research Center. 34 pp.

This report presents the first attempt, using an energy analysis, to show a National Park as an integral part of a larger system. The most important components and interactions with the model are shown using energy circuit diagrams representing subsystems such as mangrove, saltwater, sawgrass, marine meadows, etc. Pathways are evaluated numerically using available data and comparative values are given by the energy analysis. An analysis of the park fishery based on commercial and recreational catches at Flamingo was made using the retail price of fish as their value to the economy. A ratio of fossil fuel energy input using coal equivalents was made and related to increased water supply on the parks value to the regional system. Results included a land use map of park subsystems, an evaluated ENP model and summary diagrams. A floodway, from Lake Okeechobee to Conservation Area III, was proposed by the authors to restore natural flow to the park, and to serve agriculture and urban development.

Study Type:Model.

87. Defelice, D. R. 1982. Applicability of the r-selection concept to modern diatom communities. Geol. Soc. Am. Abstr. Progr. 14(7):473.

Analysis of diatomaceous sediments from two widely separated and different environments indicates that the concept of r selection may be applied to diatom communities. Diatom population sampled from the shallow benthic environment of northeast Florida Bay (ENP) and from the deep sea planktic environment of the SE Atlantic share similarities in diversity and ecological succession that conform strongly to the hypothetical r and k selectors defined by McArthur and Wilson (1967). Diversity in both areas is strongly regulated by the stability and predictability of the environment. Low diversity assemblages in both areas are almost monospecific and involve recolonization. *Cocconeis placentula* occurs in insignificant numbers on the sediment substrate in Florida Bay but it is ubiquitous on *Thalassia* grassblades whose short residence time on the plant makes the substrate ephemeral, unstable and unpredictable.-Adapted from author's abstract.

88. DeFelice, D. R. 1975. Model studies of epiphytic diatoms of upper Florida Bay and associated sounds. M.S. Thesis, Duke Univ. Durham, N.C. 193 pp.

The diatom flora of northeastern Florida Bay and adjoining sounds, primarily within the boundaries of ENP, was modeled using factor-vector analysis and species diversity indices. Of the four distinct floras identified, two were epipelic

floras inhabitating the carbonate mud substratum. One hundred and sixty-two species were identified from 30 stations, 34 of which were restricted to the epiphytic habitat and 18 species were limited to the epipelic habitat. It was found that the epipelic flora was significantly more diverse than the epiphytic flora and the diversity of floras of both habitats increased away from land areas. Factors affecting the distribution of both floral types are hypothesized.

Study Period:May 1974; Study Type:Quantitative; Habitat:Grassbeds; Biological Component:Diatoms; Gear Type:Bottom grab; Number of Stations:30; Number of Replicates/Station:3; Abiotic Parameters Measured:Sediment grain size; Dominant Taxon/Taxa Studied:*Cocconeis, Nastogolia, Nitzschia, Cyclotella, Rhopalodia, Fragilar.*

89. DeFelice, D. R. 1975. Model studies of epiphytic and epipelic diatoms. Geol. Soc. Am., Abstr. Prog. 7(7):1048.

Studies on the diatoms of NE Florida Bay (ENP) resulted in the construction of models utilizing factor-vector analysis and species diversity indices which identified four distinct floras. Two of these were epiphytic floras living on *Thalassia* which were characterized by the dominant species *Cocconeis placentula, Mastigloia crucicula, M. ovata,* and *Nitzschia closterium.* The other two were epipelic floras living on the carbonate mud substratum which were characterized by the dominant species *Cyclotella striata, Rhopalodia gibberula, Nitzschia panduriformis, Amphora actiuscula, A. coffeaiformis,* and *Fragillaria crotonensis.* The majority of the 162 diatom species were identified in both the epiphytic and epipelic floras. The epipelic flora were significantly more diverse and a general trend was found of increased diversity in both the epipelic and epiphytic habitats, away from the Everglades and the Florida Keys.-Adapted from author's abstract.

90. DeFelice, D. R. and G. W. Lynts. 1978. Benthic marine diatom associations: upper Florida Bay (Florida) and associated sounds. J. Phycol. 14:25-33.

The tropical marine diatom flora of Florida Bay (ENP) was examined during May 1974. Models of the diatom associations in upper Florida Bay and adjoining sounds were constructed, and four distinct associations were identified. Two associations were epiphytic, occurring on *Thalassia testudinum,* and two were epipelic, occurring on carbonate and substratum. The majority of the 161 species identified were present in both assemblages. The epipelic assemblage was found to be significantly more diverse than was the epiphytic assemblage. A general trend of increased diversity away from land ,toward open areas of water for both assemblages was found.

Study Period:May 1974; Habitat:Grassbed, mud; Study Type:Qualitative; Biological Component:Benthic diatoms; Number of Stations:30; Number of Replicates/Station:3; Temporal Frequency:Once; Abiotic Parameters Measured:Sediment grain size; Dominant Taxon/Taxa Studied:*Fraglaria, Cocconeis, Cyclotella, Rhopalodia, Surirella.*

91. DeFelice, D. R. and G. W. Lynts. 1979. Biotic and abiotic parameters affecting diversity in modern and ancient benthic diatom assemblages of Florida. Fla. Sci. 42. (Suppl.):44. (Abs.).

This paper reports on a study of benthic diatom communities in Florida Bay (ENP). It was found that diatom diversity is determined by various biotic and abiotic parameters, including substrate light quality, sediment particle size, and distance from land. In Florida Bay, diatoms are common in surface sediment, but absent immediately below the surface horizon; sponge spicules are the only siliceous biogenic component in the sediment. Due to the undersaturation of siliceous material in the water column and at the water interface in Florida Bay, diatoms probably dissolve soon after death, allowing rapid recycling and re-utilization of silica.-Adapted from authors' abstract.

92. DeFelice, D. R. and G. W. Lynts. 1980. Epiphytic diatoms as r-selectors in Florida Bay, Florida . Fla. Sci. 43 (Suppl.) 23. (Abs.).

The benthic diatom *Cocconeis placentula*, an epiphyte on *Thalassia testinum* grass beds in Florida Bay (ENP), was found to have the life history patterns of the theoretical 'r-selected' endpoint species. Individuals of the species are small, live in an unpredictable environment, and have high productivity and low equitability. It was found that the epheaeral nature of the grass bed requires periodic recolonization. In *C. placentula* maximum energy is delegated for reproduction such that population increase is controlled solely by the maximum intrinsic rate of natural increase (r max).-Adapted from authors' abstract.

93. Deffeyes, K. S. and E. L. Martin. 1962. Absence of carbon-14 activity in dolomite from Florida Bay. Science 136(3518):782.

A sample of dolomite crystals concentrated from Recent carbonate sediments in Florida Bay (ENP) gave a carbon-14 age greater than 35,000 years. Since Recent sedimentation in Florida Bay began less than 4000 years ago, the dolomite must be derived from older rocks, and Taft's hypothesis that dolomite is forming today is incorrect.

Study type:Quantitative; Gear Type:Surface sample; Number of Stations:1 (Oxfoot Bank);Temporal frequency:once.

94. Dewey, M. R., L. J. Mengel, N. A. Funicelli, H. E. Bryant, G. M. Ludwig and D. A. Meineke. 1989. Trammel net efficiency tests in the coastal waters of Everglades National Park. Bull. Mar. Sci. (Abstract) 44:516.

Quantitative trammel net sampling was conducted in the coastal waters of ENP from 1984 to 1985 to obtain estuarine fish standing stock estimates. Efficiency tests were conducted to obtain more accurate estimates of standing stocks from the net samples. Trammel net efficiencies were calculated for spotted seatrout, *Cynoscion nebulous*, gray snapper, *Lutjanus griesus*, pinfish, *Lagodon rhomboides*, catfish, *Arius felis/Bagre marinus*, and mullet, *Mugil cureuma/M. cephalus*. Mean efficiencies ranged from 29% for pinfish to 70% for catfish. With the methodology used in this study, an extensive number of tests would have to be conducted to

obtain minimally acceptable levels of accuracy and precision. Sampling efficiency appears to be influenced by unmeasurable and unrecorded variables including method of deployment, strike efficiency, the differential behavior of species reacting to net deployment and strike and variable habitat conditions sampled.-Adapted from authors' abstract.

95. Dimock, A. W. 1926. Florida Enchantments. New York, N.Y. Stokes. 338 pp.

Observations were made by the author on crocodiles, loggerhead turtles, sawfish, tarpon, manatees, and dolphins around the southern tip of Florida including Florida Bay and the Ten Thousand Islands, during trips for capture of specimens for the New York Aquarium.

Study Type:Qualitative; Study Period:1906; Habitat:Mangrove swamp; Dominant Taxon/Taxa Studied:Crocodiles, loggerhead turtles, manatees, dolphins.

96. Dunbar, J. R. 1974. Summary of the Neogene stratigraphy of southern Florida. IN Post-Miocene stratigraphy, central and southern Atlantic Coastal Plain. Pgs. 206-265. Logan.: Utah St. Press.

No abstract available.

97. Dunson, W. A. 1979. Occurrence of partially striped forms of the mangrove snake, *Nerodia fasciata compressicauda* Kennicott, and comments on the status of *N. f. taeniata* Cope. Fla. Sci. 42:102-112.

The estuarine snake (*Nerodia fasciata compressicauda*) is an extremely variable mangrove inhabitant which can survive long periods of immersion in sea water. There is an area of apparent integration with the sea water intolerant subspecies *N. f. pictiventris* on or near Chokoloskee Island (within and/or adjacent to the boundaries of ENP). The integrates varied markedly among each other in coloration, yet all survived for prolonged periods in sea water (at least 30 da). The superficial resemblance to *N. f. clarkii* can be ascribed to habitat similarity, and not merely to possible contact with the west coast salt marsh snakes during Pleistocene submergence of the intervening peninsula.

Study Period:June 1977; Study Type:Qualitative; Habitat:Coastal mangrove; Number of Stations:1; Biological Component:Estuarine reptiles/snakes; Abiotic Parameters Measured:Salinity; Dominant Taxon/Taxa Studied:*Nerodia fasciata compressicauda*.

98. Dunson, W. A. 1980. Osmoregulation of crocodiles in Everglades National Park. Rept. T-599. Homestead, Fla., Everglades N.P., South Florida Research Center. 29 pp.

The physiological effects of high salinity on young crocodiles, *Crocodylus acutus*, was examined in Florida Bay (ENP) using measurements of electrolyte composition of plasma and cloacal fluid and of possible hatchling food. No final answer can be given to the hypothesis that a major portion of crocodile mortality in Florida Bay

is associated with osmoregulatory problems caused by high salinities. Small *C. acutus* show few physiological specializations for life in saline waters although results indicate that the vicinity of many nest sites are saline enough that difficulties could be encountered in water and salt balance. The author suggests additional studies are needed to establish their mortality under the most stringent salinity regime ever likely naturally to be encountered.

Study Period:July 1978-February 1979; Study Type:Semi-quantitative; Habitat: Mangrove swamp; Biological Component:Crocodiles; Abiotic Parameters Measured: Salinity; Dominant Taxon/Taxa Studied:*C. acutus*.

99. Dunson, W. A. 1980. The relation of sodium and water balance to survival in sea water of estuarine and fresh-water races of the snakes *Nerodia fasciata*, *N. sipedon* and *N. valida*. Copeia :268-280.

In this study subspecies of the Florida banded water snake (*Nerodia fasciata*) were investigated to determine the possible mechanisms by which freshwater races *Nerodia fasciata* have become adapted for life in saline waters and, conversely it was important to determine which freshwater species of water snakes die in seawater. Based on specimens collected from south Florida (within ENP, Florida Bay/Chokoloskee Island) and elsewhere, and examined in seawater under laboratory conditions, it was found that the distinction between freshwater and estuarine races was not simply behavioral, as was previously believed, but is dependent also on physiological differences. It appears that these estuarine subspecies are in the process of evolving into true marine species. They may not have a salt gland, but they are capable of surviving long periods in saline habitats.

Study Type:Quantitative, qualitative; Habitat:Coastal mangrove in ENP; Biological Component:Marine reptile/snakes; Dominant Species Studied:*Nerodia f. compressicauda*, *N. f. clarkii*.

100. Dunson, W. A. 1982. Salinity relations of crocodiles in Florida Bay. Copeia 12:374-385.

Studies were carried out to determine the importance of elevated salinities as a limiting factor to the Florida Bay (ENP) population of *Crocodylus acutus*; hatchlings in captivity have been shown to be unable to survive in seawater. Evaporative water loss of hatchling crocodiles, behavioral osmoregulation, and the water and ion content of potential food items were investigated. Data reported included plasma concentrations (Na, K, Cl), osmotic pressure, cloacal fluids, and changes in body mass of *C. acutus*. It was reported that wild hatchlings have a plasma osmotic pressure level typical of vertebrates, that there was a substantial loss of water from fasting hatchlings submerged in seawater (35 ppt), and balancing of water loss can be accomplished by feeding.

Study Period:July 1978-October 1979; Study Type:Semi-quantitative; Habitat:E stuarine & marine mangrove roots, holes, beaches; Biological Component:Marine reptiles; Gear Type:Hand; Abiotic Parameters Measured:Salinity; Dominant Taxon/ Taxa Studied:*Crocodylus acutus*.

101. Dunson, W. A. and F. J. Mazzotti. 1989. Salinity as a limiting factor in the distribution of reptiles in Florida Bay: A theory for the estuarine origin of marine snakes and turtles. Bull. Mar. Sci. 44:229-244.

Salinity is hypothesized to be the major biotic factor limiting the colonization of Florida Bay (ENP) by estuarine reptiles. This premise is supported by the small number of reptile species found in the bay, the osmoregulatory specializations of these species, and a remarkable cline in the ability to tolerate sea water found among estuarine and coastal reptiles. This latter cline may represent a model of the evolutionary stages through which pelagic snakes and turtles have passed in developing adaptations for life in the open sea. Florida Bay is the only known location in this hemisphere where three specialized estuarine reptiles are sympatric: the American crocodile, *Crocodylus acutus*, the diamondback turtle, *Malaclemys terrapin*, and the mangrove snake, *Nerodia clarki*. For turtles, the most important factor in determining tolerance to high salinity is the amount of sea water swallowed incidentally with food ingestion; this finding needs to be extended to other reptiles. Four major transitional stages in the gradual evolution of marine snakes and turtles from freshwater ancestors are hypothesized, and discussed by the authors.

Study Period:Crocodiles (1976-1981); Study Type:Qualitative, quantitative; Habitat:Open bay waters, island lagoons, enclosed bay/ponds, creeks; Biological Component:Marine reptiles; Abiotic Parameters Measured:Salinity; Dominant Taxon/Taxa Studied:*Crocodylus acutus*, *Malaclemys terrapin*, *Nerodia clarki*.

102. Dunson, W. A. and M. Seidel. 1986. Salinity tolerance of estuarine and insular Emydid turtles (*Pseudemys nelsoni* and *Trachemys decussata*). J. Herptol. 20(2):237-245.

*Pseudemys nelsoni* and Trachemys decussata inhabit brackish water in mainland areas of extreme southern Florida and on Grand Cayman Island. In ENP 10 *Pseudemys* were collected along the north shore of Florida Bay near Taylor River; *Trachemys* were captured on Grand Cayman Island, British West Indies. They appear to be intermediate in their salinity tolerance between truly freshwater forms and the highly specialized estuarine terrapin (*Malaclemys*). Unfed *P. nelsoni* (730-1240 g) had especially low rates of mass loss (primarily net water loss) in 100% sea water. Data on sodium efflux values suggests a lack of salt glands in these species. Sodium influx in 100% sea water was very low in adult *P. nelsoni*. Large individuals of both species tolerated immersion in 100% sea water for prolonged periods (at least 10-24 days). Their natural habitats vary seasonally in salinity, but remain on average quite dilute due to rainfall.

Study Period:1981-83; Study Type:Qualitative, quantitative; Gear Type:Traps (none caught in ENP), hand; Number of Stations:3 sites in ENP; Habitat:Creeks, ponds, river bottoms of *Ruppia*, *Chara*, *Batophora*; Abiotic Parameters Measured:Salinity (in field & laboratory); Biological Component:Turtles; Dominant Taxon/Taxa Studied:*Pseudemys nelsoni*.

103. Durako, M. J., R. C. Phillips and R. R. Lewis III. 1987. Proceedings of the symposium on subtropical - tropical seagrasses of the southeastern United States. Fla. Mar. Res., Rept. No. 42. 209 pp.

In this report research on the subtropical-tropical seagrasses of the southeastern United States over the past 25 years was synthesized and summarized, and future research directions were recommended. Topics covered in this volume include: distribution, nutrient cycling, primary productivity, detritus production, proximate constituents, epiflora, macroalgae, reproductive biology, faunal assemblages (review of fish and invertebrate seagrass-associated studies in the Florida Bay area of ENP), food webs, human impacts, and habitat restoration. Early in the period, most research was descriptive and qualitative. By 1970, most work was becoming quantitative, and development of conceptual models was beginning. Recent research has focused on testing of these models and elucidation of mechanisms by which seagrass ecosystems develop and maintain their high rates of primary and secondary productivity.

Study Type:Qualitative, biological review.

104. Egler, F. E. 1948. The dispersal and establishment of red mangrove, in Florida. Carri. Forest 9:297-310.

No abstract available.

105. Ehrhardt, N. M. 1985. Cooperative stone crab research program Everglades National Park. Final Rep. Univ. of Miami (RSMAS) to US Fish & Wild. Serv. and NPS ENP, Homestead, Fla. 55 pp.

Several surveys conducted to assess the amount and spatial distribution of stone crabs traps fished in Park waters showed that during the period of this study, fishing for stone crabs was substantially reduced from past trends and that most fishing operations were restricted to an area along the coast of Cape Sable, and to a lessor extent on the southeast boundary of the park, along the Florida Keys. The sampling design used in this study assessed the stone crabs stocks exploited off Cape Sable and abundance estimates were obtained by direct censuses mostly through diving and by tagging. An analysis of the temporal-spatial location of increased stock abundance demonstrated that fishing operations were closely associated with areas of maximum crab abundance. Standing stock abundances in the study area ranged from 200,000 to 1,333,000 individuals based on diver surveys. Population size estimates based on tagging experiments indicated that an average of 35,071 males were in the study area during October 1984 and that this population level declined to 15,211 males through February 1985 as a result of fishing exploitation. Based on catchability coefficients, instantaneous mortality rates, it was concluded that the exploitation rate observed (0.50) during the 1984/85 fishing season in the Cape Sable area was 88.8% of that required to fully exploit the stock. Without a closed season a severe overexploitation of this resource would occur.

Study Period:October 1983-September 1985; Study Type:Quantitative; Habitat: Coastal marine; Gear Type:SCUBA, wire cable, traps, cone-anchor-spaghetti tags; Temporal Frequency:weekly/irregular; Number of Stations:42 replicated dive sites, 370 traps; Biological Component:Decapod crustacean; Dominant Taxon/Taxa Studied:Stone crab, *Menippe mercenaria*.

106. Eidman, M. 1967. Contribution to the biology of needlefishes, *Strongylura* spp., in south Florida. M.S. Thesis, Univ. of Miami, Coral Gables, Fla. 84 pp.

The biology of the needlefishes, *Strongylura* spp. was investigated from collections obtained in the Buttonwood Canal, ENP. Data are presented on spawning, fecundity, and food. Insects comprised 40% of their food. A length-weight relationship and length frequencies are given.-Adapted from author's abstract.

107. Enos, P. 1989. Islands in the bay - a key habitat of Florida Bay. Bull. Mar. Sci. 44:365-386.

Florida Bay, (ENP), contains 237 muddy islands with areas 100 $m^2$ that comprise 1.73% of the total area. The geographic distribution of island is uneven; they are least numerous in the western bay (0.76% of total area); most common in the central bay (2.89%) and intermediate in the northeastern bay (1.88%). Principal island habitats are: 1) red and black mangrove swamps; 2) algal and halophyte marshes; 3) grass "prairies"; and, 4) hardwood-buttonwood hammocks. A hierarchial classification of islands consists of islands that contain only habitat 1) mangrove swamps, 1) & 2), 1) through 3), and 1) through 4); these represent a developmental sequence. Islands are dynamic: habitats evolve, sometimes catastrophically, and islands migrate through erosion on more exposed margins and lateral accretion on protected margins. Cores from islands show that some nucleated with transgressions of the shoreline and persisted throughout the Holocene flooding of the bay. The stratigraphic history of the islands bears no obvious relationship to the habitats now present on the islands.

Study Period:1964-1987 (aerial, ortho photography, field & pers. observations); Study Type:Quantitative, qualitative; Habitat:Island mangroves, hardwood hammocks, grass prairies, algal mats; Gear Types:Piston cores; Number of Stations:Variable; Biological Component:Flora & fauna; Dominant Taxon/Taxa:*Rhizophora, Avicennia.*

108. Enos, P. 1980. Stratigraphic sequences in a shelf lagoon: Florida Bay. Geol. Soc. Am., Abstr. Progr. 12:33.

A carbonate facies mosaic is being deposited in Florida Bay (ENP), which is characterized by variable salinity, low energy and compartmentalization by mudbanks. Lithofacies are: 1) calcite "mudstone"; 2) mangrove peat; 3) aragonitic skeletal deposits from basins; 4) skeletal-pelletal deposits from mud banks; and, 5) stromatolitic wackestone from supralittoral islands. Vertical accretion forms banks and islands which then act as nuclei for lateral accretion. This sequence was probably as commonplace in ancient carbonate settings as in modern examples. Depositions, similar to that in Florida Bay will probably result in the filling of the shallow inner shelf of the Gulf of Mexico. These depositions are more episodic than continuous.-Adapted from author's abstract.

109. Enos, P. and R. D. Perkins. 1976. Evolution of Florida Bay interpreted from island stratigraphy. Am. Assoc. Petrolum Geologists Bull. 60(4):609. (Abs.).

Narrative same as in reference no. 110.

110. Enos, P. and R. D. Perkins. 1979. Evolution of Florida Bay from island stratigraphy. Geol. Soc. Am. Bull. Pt 1, 90:58-83.

The sedimentary record of most Florida Bay (ENP) islands is an asymmetric cycle consisting of a transgressive sequence followed by a regressive sequence, both formed during a continuous Holocene rise in sea level. The principal sedimentary environments of Florida Bay and the south Florida mainland are represented in the cycle by an upward succession of freshwater pond, coastal mangrove swamp, shallow bay ("lake"), mud bank, and island. Some parts of the cycle may be missing, but the sequence is always the same. Supratidal carbonate sedimentation on islands may develop from coastal mangrove swamp or by mangrove colonization of mud banks. Islands have developed from mud banks at many different times during the rise of sea level into Florida Bay, indicating that mud banks must have existed through out much of the bay's history. Florida Bay probably will evolve into a coastal carbonate plain with inland mangrove swamps and freshwater ponds, very similar to the present southwest Florida mainland.

Study Type:Quantitative; Gear type:Sediment cores; Number of Stations:Variable.

111. Estevez, E. D. 1978. Ecology of *Sphaeroma terebrans* Bate, a wood boring isopod, in a Florida mangrove forest. Ph.D. Dissertation, Univ. of South Florida, Tampa, Fla. 160 pp.

Studies were conducted on the wood-boring isopod, *Sphaeroma terebrans*, in the mangrove swamps of Florida. It was found that the influence of salinity on *S. terebrans* burrowing in red mangrove prop roots indicates greater boring rates in fluctuating higher salinity regimes which is constant with investigations by Rehm and Humm (1973, no. 316 in bibliography) of mangrove distribution along the coastal fringe of the Ten Thousand Islands (ENP) and adjacent waters. The authors suggest that root and tree loss may be beneficial to mangrove ecosystems by accelerating root germination and production.-Adapted from author's abstract. A copy of this dissertation is on file at the Univ. of South Florida, Tampa.

112. Estevez, E. D. and J. L. Simon. 1975. Systematics and ecology of *Sphaeroma* (Crustacea: Isopoda) in the mangrove habitats of Florida. Pgs. 286-304 IN: G. Walsh, S. Snedaker, and H. Teas, eds. Proceedings of the Inter. Symps. on the Bio. and Mgmt. of Mangroves. Univ. of Florida, Gainesville.

The wood-boring isopod genus *Sphaeroma* was studied in the mangrove zone of Florida, including the Ten Thousand Islands area of ENP. The systematics of a new form is described and the correct distribution in southern Florida is provided. Distributions of *S. terebrans*, including those in ENP, are compared and details of burrow structure are described. Results on the influence of salinity on isopod burrowing in red mangrove prop roots indicates greater boring rates in fluctuating, higher salinity regimes which is constant with studies by Rehm and Humm (1973, no. 316 in bibliography) of mangrove distribution along the seaward fringe of the Ten Thousand Islands (ENP) and adjacent waters. The authors conclude that root and tree loss may be beneficial to mangrove ecosystems by accelerating production and root germination.

Study Type:Qualitative; Habitat:Coastal mangrove swamp; Abiotic Parameters Measured:Salinity; Dominant Taxon/Taxa Studied:*S. terebrans*.

113. Evink, G. L. 1981. Hydrological study in the area of Cross Key, Florida. Fla. State Dept. of Transp., Bur. of Envirn., Environmental Res. FL-ER-16-81. Tallahassee, Florida. n.p.

This study is designed to evaluate the need for additional openings through the causeways in the area of Cross Key, from the Florida mainland to Key Largo. Information on this area is needed to develop plans for four-laning this section of US-1 in relation to current and past water management practices involving circulation, hypersalinity, and changes in freshwater flow. It was found that salinities on either side of Cross Key may be high during the dry season and under drought conditions. It was recommended that no further structures were needed to obtain relief from hypersaline conditions in the Cross Key area.

Study Period:October 1979-November 1980; Study Type:Quantitative; Number of Stations:Seven; Temporal Frequency:Water levels-continuous/15-min interval, salinity-monthly; Habitat:Water column; Abiotic Parameters Measured:Salinity, water level.

114. Finucane, J. H. 1964. Distribution and seasonal occurrence of *Gymnodinum breve* on the west coast of Florida 1954-57. U.S. Fish. and Wild. Serv. Spec. Sci. Rept. Fish. No. 487. 14 pp.

Studies on the distribution and seasonal occurrence of *Gymnodinum breve*, the Florida red-tide organism were conducted for a 4-year period in estuarine and neritic waters along Florida 's west coast including the Ten Thousand Islands and the western Florida Bay portion of ENP. *G. breve* was found throughout the year from Tarpon Springs to the Everglades. It was reported only once in the Florida Bay area (Cape Sable) during March 1957. Blooms were reported mainly from September to December in 1954 and 1957 whereas 1955 and 1956 were not red-tide years.

Study Period:1954-1957; Study Type:Quantitative; Habitat:Water column; Biological Component:Plankton; Gear Type:Plankton nets; Temporal Frequency:Bi-weekly/monthly; Number of Stations:Variable (23 in ENP);Abiotic Parameters Measured:Salinity, temperature, pH; Dominant Taxon/Taxa Studied:*Gymnodinum breve*.

115. Finucane, J. H. and A. Dragovich. 1959. Counts of red tide organisms, *Gymnodinium breve*, and associated oceanographic data from Florida West coast, 1954-1957. U.S. Fish & Wildl. Serv. Spec. Sci. Rept. Fish. No. 289:202-295.

Investigations on the distribution and occurrence of *Gymnodinium breve*, the Florida red-tide organism, were made from 1954 to 1957. in estuarine and neritic waters on the southwest coast of Florida, including ENP. Distributional data on *G. breve* and associated water quality characteristics are presented. It was noted that, to date, the highest known salinity value for Florida Bay occurred in Snake Bight, in July during a drought.

Study Period:1954-1957; Study Type:Qualitative; Habitat:Water column; Biological Component:Dinoflagellates; Temporal Frequency:Weekly/monthly; Number of Stations:Variable (23 in ENP); Abiotic Parameters Measured:Salinity, temperature, pH, chemical data; Dominant Taxon/Taxa Studied:*Gymnodinium breve*.

116. Fleece, J. B. 1962. The carbonate geochemistry and sedimentology of the keys of Florida Bay, Florida. M.S. Thesis. Fla. State Univ., Tallahassee.

Sediment cores were analyzed for texture and mineralogy from five keys and their associated shoals in Florida Bay. The depositional history of each site is described and comparisons are drawn between the sediment characteristics of the keys and their shoals.

Study Period:Summer 1960; Habitat:Mud, sand; Study Type:Qualitative; Gear Type:Corer; Number of Stations:5; Abiotic Parameters Measured:Sediment Grain size and composition.

117. Fleece, J. B. and H. G. Goodell. 1963. Carbonate geochemistry and sedimentology of the keys of Florida Bay, Florida. Geol. Soc. Am. Spec. Pap. No. 73:6. (Abs.).

The shoals within Florida Bay (ENP) are elongate depositional features oriented either north-west-southeast or northeast-southwest. All of the small mangrove keys within the Bay are located opn these shoals. The sediment within the Bay clastic biogenetically deposited carbonate. Five of these keys, including shoals, have been cored through their depth. The lithologies of both key and shoal borings are carbonate material. The coarse fractions are mostly mollusc shell fragments; some keys have layers of peat. Aragonite constitutes 55-80% of the carbonate; the remainder consists of low and high magnesium calcite. The organic content and the ratios of aragonite to calcite and high and low magnesium calcite are more uniform throughout the shoals than in the keys. The depositional conditions within the shoals are fairly constant, but the patterns of key development vary widely.-Adapted from authors' abstract.

118. Friedmann, E. I., W. C. Roth, J. B. Turner and R. S. McEwen. 1972. Calcium oxalate crystals in the aragonite-producing green alga *Penicillus* and related genera. Science 177(4052):891-893.

Calcium oxalate crystals occur in the marine green algae *Pencillus*, *Rhipocephalus*, and *Udotea*, known as producers of sedimentary aragonite needles. *Penicillus* is a major contributor of lime mud in NE Florida Bay (ENP). In contrast to the externally deposited aragonite crystals which are generally 15 micrometers long, the oxalate crystals are larger (up to 150 micrometers and are located in the vacuolar system of the plant). No calcium oxalate was found in the related but noncalcifying genera *Avrainvillea* and *Cladocephalus*.

Study Type:Qualitative; Dominant Taxon/Taxa Studied:*Penicillus dumentosus*; Biological Component:Marine green alga.

119. Friedman, G. M. and J. E. Sanders. 1967. Origin and occurrence of dolostones, Pages 267-348 In: G.V. Chiligar, H.J. Bissel and R.W. Fairbridge, eds. Developments in sedimentology 9A. American Elsevier Co. Inc., New York.

No abstract available.

120. Fuhr, J. M. 1987. Stratigraphy and depositional history of the Pleistocene bedrock underlying Florida Bay. M.S. Thesis, Stephen F. Austin State Univ., Nacogdoches, Tex. 122 pp.

Ten cores from Florida Bay (ENP) reveal new information concerning Pleistocene sedimentary units deposited in South Florida. Using R.D. Perkins "Q-unit" classification proposed in 1977 (no. 294 in bibliography), four units (Q1 through Q4) were recognized. A Q5 unit was not observed. Contoured maps show several paleotopographic features that influenced Pleistocene sedimentation. The Cape Sable and South Florida Highs were draped with clastics eroded from the mainland. The Pleistocene shelf edge and an open marine-platform are also discernible. Q2 time marked a switch from clastic sedimentation to in situ carbonate production. In Q3 time a barrier reef began growing at the Pleistocene shelf edge, with patch reefs growing in the back-reef area. A peloidal unit, the bryozoan facies of the Miami Limestone, was deposited in the lagoonal back-reef area during Q4 time. This deposit comprises the utmost Pleistocene bedrock immediately underlying Florida Bay.

Study Period:Summer 1985, January 1987; Study Type:Quantitative; Gear Type:Barge-mounted coring rig; Number of Stations:10; Temporal Frequency:Once; Habitat:Bedrock; Abiotic Parameters Measured:Sediment thickness; Biological Component:Fauna; Dominant Taxon/Taxa Studied:Mollusks (*Chione cancellata, Schizoporella floridana*), Coral (*Montastrea annularis*), foraminifera.

121. Funicelli, N. A., D. A. Meineke, H. E. Bryant, M. R. Dewey, G. M. Ludwig and L. J. Mengel. 1989. Movements of striped mullet, *Mugil cephalus*, tagged in Everglades National Park. Bull. Mar. Sci. 44:171-178.

The movements of striped mullet, *Mugil cephalus*, were studied from fish tagged in ENP. A total of 16,604 fish were tagged from March 1984 to September 1985. During the period December 1984 through February 1985 recaptured tagged fish moved significantly further and more northerly out of the Park's waters than they did the rest of the year. Tags were returned from 2.8% of the fish tagged along the west coast and from 0.3% of the fish tagged in Florida Bay and west coast mullet form a series of spatially overlapping stocks.

Study Period:March 1984-September 1985; Study Type:Qualitative/quantitative; Gear Type:Gill, trammel, cast nets; Number of Stations:Variable; Habitat:Water column; Biological Component:Commercial fish (water column) species; Dominant Taxon/Taxa Studied:*Mugil cephalus*.

122. Galtsoff, P. 1954. Gulf of Mexico, its origin, waters and marine life. U.S. Fish Wildl. Serv. Fish. Bull. No. 89 55:604 pp.

This report summarizes the existing information on the geology, meteorology, physics and chemistry, flora and fauna and pollution of the Gulf waters with emphasis on providing background information for a large number of new studies now underway in the region. Sections that cover the estuarine and coastal marine waters of ENP include tides and sea level (Marmer, pp. 101-118), shoreline and coasts (Price, pp. 39-63), and phytoplankton (Davis, pp. 163-171).

Study Type:Review, biology, meteorology, geology.

123. Gebelein, C. 1972. Sedimentology and ecology of a Recent carbonate facies mosaic, Cape Sable, Florida. Ph.D. Dissertation. Brown Univ., Providence, R.I. 237 pp.

Also publ. as: Dynamics of recent carbonate sedimentation and ecology - Cape Sable, Florida. Inter. Sed. Petro. Ser, Leiden & Brill., Vol 16, 115 pp. + 52 Figs. (1977).

A study of the sedimentary processes encountered in the recent, shallow marine intertidal carbonate deposits in and around Lake Ingrahm, Cape Sable (ENP) was conducted to describe the nature of facies changes, sedimentation products, and organism - sediment interactions. The following sedimentary environments were described: mud flats, subtidal muds, mangrove flats, marl prairies, and inland lagoons including zonational characteristics, organism abundance and diversity, sedimentation rates and mechanics. A total sedimentation budget was estimated by comparing recent marine deposits accumulated since the opening of the canals in 1922 which drastically changed sedimentation style from fresh-brackish water conditions to a fully marine complex. A lack of diagenesis in Lake Ingrahm was explained by the youthfulness of deposits found at Cape Sable. Cape Sable deposits were compared with recent tidal flats in the Bahamas, Persian Gulf, and ancient tidal flat sediments.

Study Period:3 years; Study Type:Semi-quantitative; Habitat:Muds; Gear Type:Sediment cores, cans, tubes; Biological Component:Benthic flora and epiphytic fauna; Number of Stations;3 transects/5 sites per transect; Abiotic Parameters Measured:Current velocity, tides, sediment analysis; Dominant Taxon/ Taxa Studied:Forams, mollusca fauna; Temporal Frequency:Weekly/seasonally.

124. Gebelein, C. and P. Hoffman. 1969. Intertidal stromatolites and associated facies from Lake Ingraham, Cape Sable, Fl. Geolo. Soc, Amer. Spec. Paper 118.

No abstract available.

125. Getter, C. D. 1981. Ecology and survival of the key silverside, *Menidia conchorum*, an antherinid fish endemic to the Florida Keys. Ph.D. Dissertation, Univ. Miami, Miami, Fla.

The key silverside, *Menidia conchorum*, was studied as a indicator of adaptions to environmental conditions in lagoonal and ponded water habitats in the lower Florida Keys. Investigations covered taxonomy, distribution, foods, reproduction, species associations, habitats, and environmental variation. Collections of *Menidia* made in nearshore estuarine areas of ENP were *M. peninsulae*. Data reported

showed that *M. conchorum* is a valid species. It occurs from Grassy Key to Key West in lagoons characterized by rapid fluctuations and wide ranges of physico-chemical parameters, feeds on planktonic crustacea and insects, grows to 58 mm SL, lives to about a year with year-round reproduction and reaches maturity at about 40 mm. Nearly all populations inhabited lagoons altered by man and the species is judged as threatened with extinction.

Study Period:1973-1980; Study Type:Qualitative; Habitat:Nearshore estuarine and marine tidal creeks, lagoons, ponds, canals; Number of Stations:44 regular sites (2 in ENP),521 irregular sites; Biological Component:Fish (Atherinid); Temporal Frequency:biweekly/diel/irregular; Gear Types:Nets; Abiotic Parameters Measured: Salinity, temperature, DO, pH, current, tidal height; Dominant Taxon/Taxa Studied:*Menidia conchorum.*

126. Getter, C. D. 1976. The systematics and biology of the poeciliid fish, *Gambusia rhizophorae*, with an account of its hybridization with *Gambusia affinis*, and *Gambusia punctata.* M.S. Thesis. Univ. of Miami, Coral Gables, Fla.

Studies were conducted on the mangrove mosquitofish, *Gambusia rhizophorae*, to determine its biology and systematics from specimens collected in the south Florida area, including the northeast Florida Bay portion of ENP. Data are presented on its distribution size, sex, and reproduction.

Study Period:1973-1976; Habitat:Mangrove swamp, tidal creek, lagoon, pond, canal; Number of stations:500+; Abiotic Parameters Measured:Salinity, temperature, DO, pH, current; Biological Component:Poeciliid fish; Dominant Taxon/Taxa Studied:*G. rhizophorae.*

127. Getter, C. D. 1982. Temperature limitations to the distribution of mangrove mosquitofish in Florida. Florida Sci 45:196-200.

From 1976 to 1980, an extensive survey conducted in southern Florida including the coastal waters of ENP, revealed a limited coastal distribution of the mangrove mosquitofish (*Gambusia rhizophorae*). Based on 521 collections and observations *G. rhizophorae* were found at 2 sites in NE Florida Bay (ENP), in Shell Creek and at 2 sites in extreme eastern Florida Bay (Dusenbury Creek and Boggy Key channel). Its recent discovery in freshwaters of Cuba indicates *G. rhiziphorae* is not salinity limited. Other studies have shown this species is intolerant of water temperatures below 17°C. It has been shown that isotherms are different in different areas of Florida Bay and the author suggests the 17°C isotherm is responsible for its distribution.

Study Period:1976-1980; Study Type:Qualitative; Habitat:Coastal mangrove; Biological Component:Fish; Dominant Taxon/Taxa Studied:*G. rhizophorae.*

128. Gilbert, C. R. (ed.). 1978. Rare and endangered biota of Florida. Vol, 4. Fishes., University Press of Florida, Gainesville. 58 pp.

A classification and description of Florida's aquatic ecosystems was provided along with definitions of status categories and a list of included species of fish. Those

rare/endangered/threatened species known to occur in the coastal areas of ENP include Key silverside, *Menidia conchorum*, Rivulus *Rivulus marmoratus*, Mangrove mosquitofish *Gambusia rhizophorae*. (As of 1990 the status of these species are under review.)

Study Type:Qualitative, biological (fish) review; Habitat:Estuarine/coastal marine in ENP; Biological Component:Fish.

129. Ginsburg, R. N., L.B. Isham, S.J. Kuperberg, and J. Bein. 1954. Laminated algal sediments of South Florida and their recognition in the fossil record. Final Rept. 54-20 to the National Science Foundation from the Marine Lab., Univ. of Miami, Coral Gables, Fl. 33 pp. + Figs.

Laminated structures in calcareous rocks (stromatolites) which are abundant in the Pre-cambian and Paleozoic have been interpreted as algal from their gross morphologic similarities with modern forms. In order to develop more rigorous criteria of algal origin, to determine what class of algae were responsible for these structures, and to assess their environmental significance, laminated sediments forming in south Florida intertidal zones were studied. Study sites in ENP included Manatee, Basin, and Crane Keys (Florida Bay). Other sites were located on rocky platforms in the lower Florida Keys. The sediments consist of dark and light colored laminae 1 mm in thickness. The laminations are formed by the alteration of heavy sedimentation with the growth of a mat of blue-green algae and associated organisms. Criteria for the recognition of ancient stromatolites are based on the presence of detrital sediment, and of structures which required a sediment-binding surface film. These stromatolites are perhaps the most reliable organic indicator of sea-level available and may provide useful geographic information.

Study Period:1953-1954; Study Type:Qualitative; Number of Stations:Florida Bay (3-5), Lower Keys (2); Temporal Frequency:1-2; Habitat:Island mud flats, open intertidal platforms; Abiotic Parameters Measured:Salinity, pH, sediment characteristics; Biological Component:Blue-green mat forming algae; Dominant Taxon/Taxa Studied:Myxophyceae, Cyanophyceae.

130. Ginsburg, R. N. 1957. Early diagenesis and lithification of shallow-water carbonate sediments in south Florida. Soc. Econ. Paleo. and Miner. Spec. Pub. No. 5:80-100.

Diagenesis and lithification include processes which convert sediment into rock. They are of special importance to the study of limestones because of the ease in which they modify texture, structure, and composition of carbonate sediments. The intense physical, chemical, and biological processes which operate during deposition comprise early diagenesis. Subsequent processes are of longer duration and less intensity and they often obscure previous sediment properties, both depositional and early diagentic. In contrast, the early phase does not mask original sediment properties. Physico-chemical precipitation of calcium carbonate in the shallow tropical seas occurs under extreme conditions of temperature, salinity, and nucleation. Examples of the processes discussed are provided mostly from the eastern Florida Bay portion of ENP (Nest, Crane, Swash, and Calusa Keys).

Study Type:Qualitative, geology review.

131. Ginsburg, R. N. 1956. Environmental relationships of grain size and constituent particles in some south Florida carbonate sediments. Bull. Am. Assoc. Petrol. Geol. 40(10):2384-2427.

An analysis was carried out on sediments taken from 2 areas around Florida Bay (ENP) in an attempt to show that the distribution of sediment producing organisms can be found using grain size and constituents of the calcareous sediments deposited. The physical environment in one area varied so greatly that no distinct distribution of organisms could be determined. It was found that variations in the environments were gradual in a reef area, allowing changes in flora and fauna to appear in the sediment analysis. The thin technique procedure used here can also be used to analyze ancient limestones in similar types of studies.

Study Type:Quantitative; Abiotic Parameters Measured:Sediment characteristics, Salinity.

132. Ginsburg, R. N. 1971. Landward movement of carbonate mud: a new model for regressive cycles in carbonates. Am. Assoc. Petro. Geo., Bull. 55:340. (Abs.).

The Florida Bay lagoon (ENP) and the tidal flats of the Bahamas and the Persian Gulf are traps for fine sediments produced on the large adjacent open platforms or shelves. The extensive source areas produce carbonate mud by precipitation and by the disintegration of organic skeletons. The carbonate mud moves shoreward by wind-driven, tidal or estuarine-like circulation, and deposition is accelerated and stabilized by marine plant and animals. Because the open marine source areas are many times larger than the nearshore traps, seaward progression of the wedge of sediments is inevitable. As the shoreline progrades seaward, the size of the open marine source area decreases, eventually reduced progradation of mud no longer exceeds slow continuous subsidence and a new transgression begins. When the source area expands so that production again exceeds subsidence a new regressive cycle starts. These results suggested by the model should be observable in ancient deposits.-Adapted from author's abstract.

133. Ginsburg, R. N. 1954. Early diagensis and lithification of south Florida carbonate sediments. Jour. Sed. Petrology 24:138 (Abs.).

Narrative same as in reference no. 130.

134. Ginsburg, R. N. (ed.). 1972. South Florida carbonate sediments. Sedimenta II., Comparative Sedimentology Laboratory: Univ. of Miami, Fisher Island Station, Miami Beach, Fla. 72 pp.

A field trip guidebook to the Recent carbonate sediments of Florida Bay (mostly within the boundaries of ENP) and Florida Reef Tract was presented. The following characteristics of Florida Bay were described: sedimentation and water circulation patterns, sedimentation patterns, sediment composition, and molluscan fauna. The corals and coralline algae of the reef tract are identified and their ecology and

roles in sedimentation are discussed. Rodriguez Bank adjacent to the reef tract was used as an illustration of zonation of sediment producing plants and animals. The spur and groove formation in the reef tract, Pleistocene limestones in the Florida Keys,and recent dolomite of Sugarloaf Key are also discussed in the guidebook.

Habitat:Coastal marine; Study Type:Qualitative; Biological Component:Fauna and flora.

135. Ginsburg, R. N. and H. A. Lowenstam. 1958. The influence of marine bottom communities on the depositional environments of sediments. J. Geol. 66:310-318.

The effects of benthic fauna on the sediment environment in Florida Bay (ENP) was examined. This investigation described the ability of organisms, apart from reef builders, to control or modify their physical environment. It was found that certain organisms cause recognizable differences in sediment and other organisms.

Study Type:Qualitative; Habitat:Rock, mud, sand, grass; Biological Component:Fauna.

136. Given, P. H. 1971. Distribution of forms of sulfur in peats from saline environments in the Florida Everglades. Geol. Soc. Amer. Abstr. Prog. 3:580.

Peat deposits influenced by marine waters have higher pyrite and organic sulfur contents compared with fresh water deposits. The principal source of sulfur in saline conditions is the sulfate ion. A peat core in a mangrove swamp environment (ENP) was analyzed at various depths for $H_2S$, acid-soluble sulfides, pyrite, elementary sulfur, organic sulfur, and sulfate ion. A second core was made in the brackish-water environment. Concentrations fluctuated with depth rather than show progressive trends. Ferrous sulfide, the presumed precursor of pyrite, and free sulfur was found at low concentrations. The production of reduced forms of sulfur were attributed to the activities of bacteria, yet the oxidizable and reducible species in peat do not constitute an equilibrium system, the rate of reaction being slow.-Adapted from author's abstract.

137. Gleason, P. J., A. D. Cohen, W. G. Smith, H. K. Brooks, R. L. Stone, R. L. Goodrick and W. Spackman. 1974. The environmental significance of Holocene sediments from the Everglades and saline tidal plain. p. 287-341. IN Gleason, P.J. (ed.). Environments of south Florida: Present and past. Memoir 2, Miami Geol. Soc., 452 pp.

This article presents a review and discussion on the distribution, age, composition, rates of deposition, and depositional environments of macroscopically identifiable organic and inorganic Holocene sediments of interior and marginal areas of south Florida including the coastal region of ENP. Three topics discussed in regards to the ENP coastline include: sedimentological changes which have occurred in the peats and with respect to freshwater calcitic muds within the Taylor Slough, transgression and regression of the sea, and evidence for climatic change during the Holocene.

Study Type:Qualitative, geologic review.

138. Goodell, H. G. and D. S. Gorsline. 1961. Data Report on the hydrography of Apalachicola and Florida Bays. Florida. Fla. St. Univ. Sediment. Res. Lab. Contri. No. 1. 316 pp.

Investigations on the hydrology and marine geology of Appalachicola and Florida Bays were carried out to show the effects of hydrology on sedimentation and the interrelationships between sedimentation and bottom morphology on water motion and exchange within the bays. This report presents the hydrological data collected during the first years work; no analysis of the data is presented herein. Future reports will cover the analysis of hydrological and sedimentological data.

Study Period:March 1960 - January 1961; Habitat:Water column; Study Type: Qualitative; Number of Stations:8 (3 in ENP); Temporal Frequency:Diel on a monthly basis; Abiotic Parameters Measured:Salinity, temperature, pH.

139. Gorsline, D. S. 1963. Environments of carbonate deposition Florida Bay and the Florida Straits. In R.O. Bass (ed): Shelf carbonate of the Paradox Basin, Four Corners Geol. Soc., Fourth Field Conf. Symp. pp. 130-143.

No abstract available.

140. Gorsline, D. S. 1965. Final data report marine geology and oceanography of Florida Bay, Apalachicola Bay and vicinity, Florida. Observation period - January to December 1962. Report No. USC Geol. 65-1, Florida State Univ., Tallahassee.

Data are presented on hydrographic and sedimentologic collections from Apalachicola Bay and Florida Bay (partially within the boundaries of ENP) as well as on sedimentologic collections from north Florida Gulf coast beaches and bays. Data reported includes locations of stations, bathymetric charts, temperature, salinity, oxygen, silica alkalinity, pH at the surface, 1.5, and 3.0 meters along with beach profiles from the northern Gulf coast.

Study Period:January-December 1962; Study Type:Qualitative; Number of Stations:Variable (3 in ENP); Habitat:Water column, mud; Temporal Frequency:Monthly, diel/monthly; Abiotic Parameters Measured:Salinity, temperature, DO, silica, alkalinity, pH.

141. Green, M. A. 1975. Survey of endolithic organisms from the Northeast Bearing Sea, Jamaica, and Florida Bay. M.S. Thesis, Duke Univ., Durham, N.C.

A comparative analysis of endolithic organisms within carbonate substrates from polar and tropical regions was undertaken to determine to what extent these microboring assemblage differ and what microboring organisms are present in each regime. Substrates were retrieved from Jamaica and from sites in Swash Keys Basin and Long Sound, Florida Bay (ENP). Assemblages observed in Florida Bay samples were composed primarily of blue-green algae (*Mastigocoleus testarum*,

*Plectonema* sp., *Hyella caespitosa*) and green algae (*Ostreobium brantium*). Little distinction could be made between endolithic assemblages from Jamaica and Florida Bay.

Study Period:1967-1969; Study Type:Qualitative; Gear Type:Grab, planted substrates; Number of Stations:Florida Bay (2), Jamaica (5); Temporal Frequency:Florida Bay (substrates exposed for 2 year period); Habitat:Planted substrates of conch and calcite rhombs; Abiotic Parameters Measured:Salinity; Biological Component:Algae (Endolithic organisms); Dominant Taxon/Taxa Studied:*Mastigocoeleus testarum, Plectonema* sp., *Hyella caespitosa, Ostreobium brabantium.*

142. Hall, R. J., T. E. Kaiser, W. B., Jr. Robertson and P. C. Patty. 1979. Organochlorine residues in eggs of the endangered American crocodile (*Crocodylus acutus*). Bull. Environ. Contam. Toxicol. 23:87-90.

Samples of eggs of the American crocodile, *Crocodylus acutus*, were collected in 1977 from the Florida Bay portion of ENP and analyzed for organochlorine contaminants. The results were compared to egg samples collected during 1972 (See Ogden et. al. 1974, no. 286 in bibliography). In this study the egg samples contained a variety of pollutants including DDT, DDE, PCB'S, DDD, dieldrin, and chlordane. DDT and DDD were significantly higher in 1972 samples than levels recorded in the current sample, thus suggesting a decline in residue during the interim. PCB'S were not reported in the 1972 sample but were present in relatively great amounts in the later sample. DDE and dieldrin levels were lower than those reported in bald eagle and brown pelican eggs, therefore, it seems unlikely that residues in *Crocodylus* eggs are affecting reproductive success.

Study Type:Quantitative; Study Period:1977; Biological Component:Marine reptile; Dominant Taxon/Taxa Studied:*Crocodylus acutus.*

143. Halley, R. B. and R. P. Steinen. 1979. Ground water observations on small carbonate islands in southern Florida. Pgs. 82-89 IN R. B. Halley, compiler, Guide to sedimentation for the Dry Tortugas, Southeastern Geol. Soc. Publ. 21.

In this study, observations on ground water from Loggerhead Key, a sand key in the Dry Tortugas, are compared with similar observations from Cluett Key, a mud key in western Florida Bay (ENP). The ground water of Loggerhead and Cluett Keys differs significantly from surrounding sea water despite the relatively small size of these islands. Climate alone did not determine the character of these ground waters. Ground water from under such small islands as these is formed from a complex array of variables that affect the hydrology of the islands. Island ground waters serve as geologic agents, hastening the alteration of marine carbonate sediments to limestone and dolomite.

Study Period:1976; Study Type:Quantitative, qualitative; Habitat:island; Abiotic Parameters Measured:Sediment & ground water characteristics, salinity.

144. Halpern, J. A. 1970. Growth rate of the tropical sea star Luidia senegalensis (Lamarck). Bull. Mar. Sci. 20:626-633.

Investigations on the growth of the sea star, *Luidia senegalensis* were carried out from collections made on the SW coast of Florida (ENP) November 1965 through February 1966. Results of a food habits analysis showed that the bivalve, *Albra acqualis*, was the principal food source. It was found that the growth rate of *L. senegalensis* was much greater than that of temperate asteroid species.

Study Period:November 1965-February 1966; Habitat:Shell,sand; Study Type:Quantitative; Biological Component:Echinodermata; Gear Type:Otter trawl; Number of Stations:1; Number of Replicates/Station:7; Temporal Frequency:Monthly; Abiotic Parameters Measured:Salinity, temperature; Dominant Taxon/Taxa Studied:*Ludia senegalensis*.

145. Harrigan, P. 1986. The food web of the gray snapper, *Lutjanus griseus*, a stable isotope approach. M.S. Thesis, Univ. of Viriginia, Charlottesville, Va. 117 pp.

To determine if gray snapper, *Lutjanus griseus*, are dependent on seagrass as a base of nutritional support, a combined stomach content analysis and stable carbon and isotope analysis was utilized to assess the contribution of various primary organic sources (POS) to its food web from, each, a seagrass dominated (Florida Bay) and a mangrove dominated (Whitewater Bay) area in ENP. The results from the stomach contents analysis indicated that gray snapper from each food web had similar diets, consisting mostly of shrimp supplemented by fish or fish and crabs. Isotopic results reveal that the food webs are isotopically similar to the dominant vegetation. Estimates of trophic level fractionation were 3.2 and 1.3% for nitrogen and carbon respectively. Both qualitative and quantitative results suggest that nutritional support to food web members is derived from seagrass in the seagrass dominated location and from mangrove, *Rhizophora mangle*, and benthic vegetation, *Ruppia maritima*, in the mangrove dominated area. Despite the isotopic distinction between areas, within each food web carbon and nitrogen are transferred through a detrital food web by similar mechanisms.

Study Period:June-Sept. 1983, Sept. 1984; Study Type:Qualitative, quantitative; Habitat:Seagrass bed, mangrove; Biological Component:Flora,fauna; Gear Type: Fish(hook & line), prey items(seine; sled, push, & stop nets; trawls, dip nets, traps), seagrass(10 x 20 cm quadrats); Number of Stations:2; Temporal Frequency: irregular; Abiotic parameters Measured:Water depth, salinity, temperature; Dominant Taxon/Taxa Studied:*Lutjanus griseus*, *Penaeus duorarum*, *Thalassia*, *Ruppia*.

146. Harrigan, P., J. C. Zieman and S. A. Macko. 1989. The base of nutritional support for the gray snapper (*Lutjanus griseus*) in Florida Bay, Everglades National Park, Florida. Bull. Mar. Sci. 44:65-77.

In this study, a combined stomach content and stable isotope analysis was used to determine if seagrass provides a base of nutritional support for the gray snapper. The contribution of carbon and nitrogen from various primary organic sources to gray snapper taken from each a mangrove (Whitewater Bay area) and a seagrass (Florida Bay/ENP) dominated area are examined. Gray snapper from

both areas had similar diets, composed primarily of penaeid shrimp. A distinction in food webs was provided by isotopic analysis. Fish from the seagrass beds derived more than 90% of their carbon and nitrogen from sediment or water column organic material. Snapper from mangroves were supplied with carbon, nitrogen, detritus; main contributors appeared to be POM from the water column and brackish water grass, *Ruppia maritima*. These results suggest that within both food webs carbon and nitrogen are transferred from a detrital base by similar mechanisms and emphasize the use of isotopes as a tool for evaluating food webs.

Study Type:Quantitative; Study Period:June-September 1983; Habitat:Estuarine mangrove swamp/marine seagrass bank; Gear Type:Trawl, H & L; Biological Component:Sportfish, isotopic composition; Dominant Taxon/Taxa Studied:*L. griseus*.

147. Harriss, R. C., H. Mattraw, G. J. Horvath and A. Andren. 1971. Input, cycling, and fate of heavy metal and pesticides pollutants in estuaries of the western Everglades. Final Rept. to the NPS from the Marine Lab., Fla. State Univ., Tallahassee.

This report contains the results of the first phase of an investigation of the sources, dispersion mechanisms, and ecological impact of heavy metals and chlorinated hydrocarbon pesticides on the estuaries of the western section of ENP. The most important findings of the study are: 1) Agricultural activities located north of the park are a source of heavy metals and chlorinated hydrocarbon pesticides to the ENP estuaries. Heavy applications of chemicals for plant nutrition and pest control have produced soils with average iron, copper, manganese, zinc, and lead concentrations up to six times greater than presently uncontaminated estuarine soils and sediments; 2) The measured gradients for iron, copper, manganese, zinc, and lead suggest that migration of these metals into the estuarine environment is occurring; 3) Suspended sediments from drainage canals contain the highest copper, nickel, zinc, and cadmium values measured; 4) The cation exchange capacity of the soils and sediments studied increases with increasing organic content; 5) Concentrations of mercury up to 1.8 ppm have been measured in sediments with no likely source of artificial contamination. A very strong correlation was found between cation exchange capacity and mercury content in the sediments.

Study Period:May 1971; Study Type:Quantitative; Gear Type:Piston tube (sediments), hand (plant material); Number of Stations:22 (8 in ENP); Temporal Frequency:Once; Habitat:Water column, sediments: Biological Component:Flora; Abiotic Parameters Measured:Sediment characteristics, trace metals (Fe, Mn, Zn, Cu, Ni, Co, Pb, Cd), suspended matter; Dominant Taxon/Taxa Studied:*Pistia*.

148. Heald, E. J. 1970. The Everglades estuary: an example of seriously reduced inflow of fresh water. Trans. Am. Fish. Soc. 99:847-848.

This paper presents a description of reduced freshwater flow to the estuarine regions of ENP caused by drainage and irrigation schemes in the central portion of the state. The net result of the freshwater reduction was a lowering of the water table as much as 6 feet, a gradual landward intrusion of saltwater, increased salinities in the estuarine bays and lagoons, and a reduction in the capacity of the

system to withstand stresses of normal drought. At extremely high salinities, the dominant producer of the bay, *Thalassia testudinum*, is severely limited.

Study Type:Qualitative, review; Habitat:Estuarine.

149. Heald, E. J. 1969. The production of organic detritus in a south Florida estuary. Ph.D. Dissertation. Univ. of Miami, Coral Gables, Fla. 110 pp.

Also publ. as: Sea Grant Tech. Bull. No. 6, Univ. of Miami Sea Grant Prog., Miami, Fl. 1-110 p. (1971).

During 1967 and 1968 in the North River, ENP, the annual production of organic debris by red mangrove, Juncus, and sawgrass was studied. The rate of decomposition and the manner of degradation were determined, as well as the total contribution by each producer to the detrital load of the river. It was found that annual production exceeded 3 metric tons/acre, of this, 90% was produced by red mangrove. Degradation of red mangrove leaves was most rapid in brackish water as opposed to freshwater and the terrestrial environs. Two species of amphipods and a xanthid crab were consumers in brackish water. Seasonally the quantity of detritus was highest in the river from November-February; mangrove detritus accounted for 35-60% of the total suspended material/month. The nutritive value of mangrove detritus, its significance as a energy source in the estuarine ecosystem, and the importance of the mangrove community to adjoining bays is considered.

Study Period:1967-1968; Habitat:Mangrove, saltmarsh; Study Type:Quantitative; Biological Component:Flora and Fauna; Number of Stations:4; Temporal Frequency:Monthly; Abiotic Parameters Measured:Salinity; Dominant Taxon/Taxa Studied:*Rhizophora mangle,Juncus,amphipods (Melita melita, corophium lacustre)*, xanthid crab (*Rithropanopeus harrisi*).

150. Hendrix, G. Y. and J. M. Morehead. 1983. Everglades National Park: Imperiled wetland. AMBIO 20(3-4):153-157.

This paper reports on the present status of ENP, a wetland under fire from various developmental and recreational interests. A brief historical resume of ENP is presented including water delivery alterations, declines in wading bird populations and of park fisheries, endangered species protection, and invasions of exotic species was discussed as well as the mission of the park's South Florida Research Center - to monitor the effects of water management upon the ecology of the Everglades.

Study Type:Environmental review, qualitative.

151. Henshall, J. A. 1891. Report upon a collection of fishes made in southern Florida during 1889. Bull. U.S. Fish. Comm. 9: 371-389.

A list of fishes collected in the Cape Sable area was provided.

Study Type:Qualitative.

152. Hettler, W. F., Jr. 1989. Food habits of juveniles of spotted seatrout and gray snapper in western Florida Bay. Bull. Mar. Sci. 44:152-165.

This study examines the stomach contents of 144 juvenile spotted seatrout and 215 juvenile gray snapper collected by trawl or rotenone from shallow seagrass flats, deep bank channels, or mangrove prop root habitats in western Florida Bay (ENP). Both species fed almost exclusively on crustaceans and fishes. Smaller non-decapod crustaceans were more abundant in the smallest size classes (<50 mm SL). Penaeid shrimp, the most numerous prey in both fishes, and caridean shrimp increased in percent occurrence with fish growth. Fish were important in size classes above 150 mm SL. Rainwater killifish, *Lucania parva*, was the most common fish consumed. Abundant stocks of juvenile penaeid shrimp are important in supporting large populations of juvenile spotted seatrout and juvenile gray snapper.

Study Period:May 1984-September 1985; Study Type:Quantitative, qualitative; Gear Type:Trawl, rotenone; Biological Component:Sportfish, nonfishery sp.; Dominant Taxon/Taxa Studied:Spotted seatrout, gray snapper, rainwater killifish, penaeid shrimp.

153. Higman, J. B. 1967. Relationships between catch rates of sport fish and environmental conditions in Everglades National Park, Florida. Proc. Gulf and Carib. Fish. Inst. 19:129-140.

Increased fishing pressure in ENP resulted in a request by the NPS to determine if regulation of the of the sportfishery was required. Over a period of seven years a program was developed by the University of Miami to measure the catches of gamefish and effort within ecologically different fishing areas of ENP. Anglers were interviewed at Flamingo in the central part of ENP. Discussed are sampling procedures, calculation of CPUE and sample size determination. It was found that most sportfish stocks have not been reduced; the seasonal availability of the most popular sportfish, spotted seatrout, mangrove snapper, and red drum are apparently related to the congregation of fish for spawning and by the responses of fish to changes in environmental conditions, including salinity, temperature, and rainfall.

Study Period:1959-1965; Habitat:Estuarine and coastal marine; Study Type: Quantitative; Biological Component:Sportfish; Gear Type:H & L; Temporal Frequency:Monthly; Abiotic Parameters Measured:Air & water temperature, salinity, rainfall; Dominant Taxon/Taxa Studied:Red drum spotted seatrout, gray snapper.

154. Higman, J. B., B. J. Yokel and M. A. Roessler. 1972. Growth of pink shrimp in the Everglades estuary, 1968-71., Univ. Miami, Miami, Fla., Final Report UM-RSMAS-72007 to NOAA, NMFS, 55 pp.

The growth of juvenile pink shrimp, *Penaeus duorarum*, and environmental conditions during growth were monitored at enclosure sites in the Whitewater - Coot Bay area of ENP. Carapace length -weight relationships were determined for shrimp growth in enclosures. There was no significant difference between the two bays in the gain in weight per unit increase in length. Relationships between

environmental conditions and shrimp growth revealed conflicting results between experimental sites. The authors suggested that conditions not measured influenced growth and masked growth-temperature-salinity relationships. Separate studies on the mangrove root environment and the adjacent bottom as a habitat for shrimp showed that *Penaeus* were abundant over vegetated (*Udotea/Halimeda*) mud bottom, sparse on loose peaty bottoms, and absent on scoured bottoms. At night shrimp extended their activities from mud bottoms into the adjacent mangrove prop root zone.

Study Period:October 1968 through March 1971; Study Type:Qualitative, quantitative; Habitat:Mangrove swamp (peat, clay, mud bottom); Biological Component:Penaeid shrimp; Number of Stations:2 (enclosures), 3 (prop root studies); Number of Replicates/Station:5/prop root study); Temporal Frequency:Weekly/monthly; Abiotic Parameters Measured:Salinity, temp., DO; Dominant Taxon/Taxa Studied:*Penaeus duorarum*.

155. Hoffmeister, J. E. 1974. Land from the Sea. Univ. of Miami Press: Coral Gables, FL. 143 pp.

This book presents an introduction to the geologic history, formation and topography of south Florida. Those chapters pertinent to the marine environment of ENP concern bedrock/mud bank formation, limestone production, including a brief summary of the geologic history of Florida Bay and the Ten Thousand Islands with a discussion of the geologic work of mangroves (encroaching over oyster beds), sea level changes, Everglades water resources, and saltwater encroachment.

Study Type:Geologic review, qualitative.

156. Hoffmeister, J. E., K. W. Stockman and H. G. Multer. 1967. Miami limestone of Florida and its recent Bahamian counterpart. Geol. Soc. of Amer. Bull. 78:175-190.

The Miami Limestone contains an upper oolitic and a lower bryozoan facies. The bryozoan facies is the surface rock of the southern Everglades, ranging in thickness from 10 ft in southeastern Florida, thinning to 1 ft. westward to the Gulf of Mexico including the Florida Bay area of ENP. It is one of the most extensive bryozoan limestones in this country. The bathymetric and ecologic conditions now extant in this area are probably similar to those which existed during the Pleistocene to form the units of the Miami Limestone.

Study Type:Qualitative, geologic review.

157. Holden, M. W. 1965. Further notes on sea turtle nesting on Cape Sable. Open File Rept. N1415. ENP, Homestead, FL. 8 pp.

This paper describes a follow-up study on sea turtle nesting on Cape Sable beaches during the summer of 1965. On-ground and aircraft observations indicated the continued success of nesting (246 observed crawls), however as many as 80% of the nests were thought to have been destroyed by racoons. Artificial nest boxes, used to prevent the racoons from getting at the eggs, resulted in a hatching

success of 44%. Recommendations are given to increase the hatching rate, if the artificial nest continues the following year and on racoon removal methodology.

Study Period:May-August 1965; Habitat:Beaches; Gear Type:On-ground & aircraft observations; Biological Component:Marine turtles; Dominant Taxon/Taxa Studied:Loggerhead turtle, *Caretta caretta*.

158. Holden, M. W. 1964. Sea turtle nesting survey on Cape Sable beach, Everglades National Park, Florida, 1964 season. Open File Rept. N4415. ENP, Homestead, FL.

This paper presents the earliest known NPS report of sea turtle nesting on Cape Sable. It is the traditional nesting ground for the loggerhead turtle, *Caretta caretta*, and once was used by the green turtle, *Chelonia mydas*. Five miles of beach was surveyed, from East Cape to SE of Middle Cape. Data is provided on the marking and counting of turtle crawls, destroyed nests, and hatching with additional notes on racoon observations in the survey area.

Study Period:May-August 1964; Study Type:Qualitative; Habitat:Beaches; Gear Type:Field observations: Biological Component:Marine turtles; Dominant Taxon/Taxa Studied:*Caretta caretta*.

159. Holliday, V. E. 1985. Mechanisms of deposition of a carbonate mud spit: Ramshorn Spit, eastern Florida Bay. M.S. Thesis. Lehigh Univ., Bethlehem, Pa.

In this report four sediment types based on particle size distribution, organic content, and faunal assemblages are described from core samples taken at Ramshorn Spit, eastern Florida Bay (ENP). The basic types were: (1) very thin discontinuous shelly packstones, representing storm deposits; (2) thin continuous basal shelly packstones, the initial marine deposit on bedrock; (3) muddy wackstones, of variable thickness, deposited in the presence of seagrass; (4) very thick, fairly laminated fine mudstones, with very sparse fauna, representing transported sediments out of suspension. These classifications were confirmed by discriminant analysis which showed that these sediment layers were correlatable between cores, indicating a change in stratigraphy southwestward from the spit and bank junction. The author concludes that Ramshorn Spit, throughout its depositional history, seems to have been accreting outward into the surrounding "lake" by means of a current-transported mud fraction; sediments are subsequently stabilized by turtle grass cover.

Study Type:Quantitative, qualitative: Habitat:Mud bank; Biological Component:Fauna; Abiotic Parameters Measured:Sediment characteristics.

160. Holliday, V. E. and J. M. Parks. 1985. Mechanisms of deposition of a carbonate mud spit; Ramshorn Spit, eastern Florida Bay. Am. Assoc. Petrol. Geol. Bull. 69:266. (Abs.).

The turtle grass, *Thalassia testudinum*, community has a significant influence on sedimentation in Florida Bay, but the roles other processes may play in the buildup of mud bank and spit sediments are poorly understood. Samples taken from cores at Ramshorn Spit and Ramshorn Shoal (ENP), were classified into four

basic types and described on the basis of particle size distribution, organic content, and faunal assemblages. Discriminant function analysis confirms the classifications, shows that these sediment layers are correlatable between cores, and suggests a change in stratigraphy southwestward from the spit and bank junction. Thus, Ramshorn spit seems to be accreting outward into the surrounding "lake" by means of a current-transported mud fraction. The sediments are subsequently stabilized by turtle grass cover.-Adapted from authors' abstract.

161. Holmes, C. W. 1962. Sediments of the Ten Thousand Islands. M.S. Thesis., Fla State Univ., Tallahassee.

The nature of the sediments of the Ten Thousand Islands, mostly within the boundaries of ENP, were investigated from samples collected at 8 stations during June 1960. Four physiographic areas were identified: mangrove barrier, coarse quartz sand, fine quartz sand, and a mixture of the 2 sand populations. The locations of these areas and the methods of their formation are discussed.

Study Period:June 1960; Study Type:Qualitative; Habitat:Sand, coastal mangrove; Number of Stations:8; Abiotic Parameters Measured:Sediment grain size.

162. Holmes, C. W. and R. G. Evans. 1963. Sedimentology of Gullivan Bay and vicinity, Florida. Sedimentology 2(3):189-206.

Greater Gullivan Bay lies between Cape Romano shoals and the Ten Thousand Islands on the extreme western border of ENP. Two main currents affect the area, a longshore current from the north and a tidal current from the south. Regionally, the sediment coarsens seaward. Percent carbonate and organic material is lower in the bay sediments than elsewhere in the region. In the lee of the shoals, head of the bay, and in the bays of lagoonal chain, current activity is low. The lower bay, because of the turbulent ebbing of the tidal current, is in general, receiving only quartz sand. The shoals appear to be moving shoreward.

Study Type:Quantitative; Habitat:open water bay, nearshore; Abiotic Parameters Measured:Sediment characteristics.

163. Holmquist, J. G., G. V. N. Powell and S. M. Sogard. 1989. Decapod and stomatopod assemblages on a system of seagrass-covered mud banks in Florida Bay. Mar. Biol. 100:473-483.

The latticework of seagrass-covered mud banks in Florida Bay (ENP), divides the bay into distinct sub-environments and support a robust seagrass community subject to pronounced physical stress. Throw-trap sampling of decapods and stomatopods during 1984 and 1985 (December-April, May-August and September-November of each year) showed that bank sides exposed to turbulence had low abundance but similar species richness to that of bank tops and sheltered sides. The fauna was more Gulf-Carolinean than Antillean. The crustacean communities of the different sub-environments, however, were distinct, with both Antillean and temperate assemblages represented. The two sub-environments adjacent to the Atlantic Ocean and the Gulf of Mexico had the greatest densities.

Multiple-regression techniques suggested that physical factors played a more important role than vegetational characteristics. It was hypothesized that restricted circulation, juxtaposed faunal provinces, and the wider salinity range of the isolated regions of the bay were responsible for the different communities of the sub-environments.

Study Period:Two years (1984-85); Study Type:Qualitative, quantitative; Gear Type:1 $m^2$ throw-trap; Number of Stations:4; Temporal Frequency: Three sampling periods per year (dry, wet, wet seasons); Number of Replicates:Six samples along each of three 70-m transects at each site; Habitat:Mud banks; Biological Component:Decapod crustaceans, stomatopods, vegetation; Abiotic Parameters Measured: Salinity, temperature, depth, tides, sediment characteristics; Dominant Taxon/Taxa:Hippolytidae, Palaemonidae.

164. Holmquist, J. G., G. V. N. Powell and S. M. Sogard. 1989. Sediment, water level, and water temperature characteristics of Florida Bay's grass-covered mud banks. Bull. Mar. Sci. 44:348-364.

Florida Bay (ENP) a shallow lagoonal estuary, is divided into basins by a latticework of mud banks, which exert a disproportionate influence on the bay ecosystem. Prevailing northeasterly winds resulted in distinct sheltered and exposed sides on narrow banks. Bank water levels were highest in fall. Lunar tidal flux was related to the degree of access to open ocean. Water levels demonstrated wind-dependency at all sites and on narrow banks water levels were highly correlated with those of basins. Bank temperatures ranged from 7.5 to 37.0°C with a daily mean range of 4.5°C and was a function of air temperature and water level. For bank organisms, banks should represent more stressful habitat than deeper grassbeds.

Study Period: 1984-86; Study Type:Qualitative, Quantitative; Number of Stations:6, 4-quantitatively, 1984-85; Temporal frequency:Water level, temperature-continuously, wind-3-h intervals, flow rates-15-min intervals; Number of Replicates/Station:Nine sediment samples from each site, three samples from a transect on the bank top and three from each bank margin; Habitat:Mud banks, water column; Abiotic Parameters Measured:Water level, temperature, wind, sediment characteristics.

165. Horvath, G. J. 1973. The geochemistry and transport of Mn, Fe, Co, Cu, Zn, Cd, and Pb, in the freshwater and estuarine environments of the Big Cypress-Everglades region of Florida. Ph.D. Dissertation, Fla. State Univ., Tallahassee. 100 pp.

This study was designed to investigate the aquatic chemistry of seven heavy metals, manganese (Mn), iron (Fe), cobalt (Co), copper (Cu), zinc (Zn), cadmium (Cd), and lead (Pb), and to evaluate the effects of agricultural utilization of drained land in the Big Cypress Swamp on the distribution and abundance of these metals in estuaries of NW ENP. Metals studied were selected on the basis of their presence in fertilizers and pesticides. The Barron River Canal which drains farm lands in Collier County is connected to Chokoloskee Bay in ENP. Lostman's Five Bay and the Broad and Shark Rivers in ENP, which receive drainage only from natural wetlands, were studied to provide a reference level for metal concentrations present

in Chokoloskee Bay. Metal concentrations were higher in the Canal during the wet season due to extensive use of fertilizers and sprays and backpumping. Concentration levels of metals (Cd, Cu, Zn and Pb) were higher in Chokoloskee Bay than those present in other ENP estuaries and may have adverse effects on some organisms.

Study Period:October 1971, February and June 1972; Study Type:Quantitative; Number of Stations:27 (Only 3 exact ENP sites given); Temporal Frequency:3 study periods; Habitat:Water column; Abiotic Parameters Measured:Sediment Load, DOC, POC, Eh, pH, salinity, flow, Mn, Fe, Co, Cu, Cd, Pb, Zn).

166. Horvath, G. J., R. C. Harriss and H. Mattraw. 1972. Land development and heavy metal distribution in the Florida Everglades. Mar. Poll. Bull. 3:182-184.

Water samples were collected in October 1971 to make a quantitative appraisal of the impact of Big Cypress agricultural region on the distribution and abundance of heavy metals in the Everglades estuaries. The concentrations of six metals (Manganese, cobalt, copper, zinc, cadmium, and lead) from the Barron River canal-Chokoloskee Bay system as determined by atomic absorption spectrophotometry were compared to the dissolved metal content of Lostman's Bay (ENP), a natural drainage without an obvious source for heavy metals. Results indicate that copper, cadmium, and lead exhibited maximum concentrations in Chokoloskee Bay while surprisingly high dissolved lead concentrations were found in Lostman's Bay. The occurrence of these metals in the waters of south Florida could have serious ecological implications with respect to chronic effects on animal behavior and changes in community structure due to differential susceptibility.

Study Period:October 1971; Study Type:Quantitative, qualitative; Number of Stations:2; Temporal Frequency:Once; Habitat:Water column; Abiotic Parameters Measured:Manganese, cobalt, copper, zinc, cadmium, lead.

167. Houde, E. D. 1971. Survey of the literature relating to sport and commercial fishes of south Florida. Univ of Miami, RSMAS. Final Rept. to NMFS, St. Petersburg, Fla. 95 pp.

A briefly annotated list of 487 references, mostly produced between 1960-70 was compiled for this report. All Univ. of Miami theses pertinent to the bibliography were examined. An additional 27 references were included from surveys of fishes in Florida. No references discussing shellfish were included in this bibliography.

Study Type:Qualitative, bibliography, review (Finfish).

168. Hovorka, S. D., P. E. Luttrell and T. D. Murphy. 1976. Facies relationships and depositional history of south Florida carbonate mud banks. Geol. Soc. Am.; Abstr. Progr. 8:23-24.

Interior Florida Bay (ENP) consists of shallow 1-3 m deep semicircular basins separated by a network of elongate shoals (banks) and low mangrove islands. Probe and core samples were used to determine geometry of Holocene carbonate sediments and to interpret depositional history and evolution of banks and

associated keys. Areas of mangrove peat on the irregular Pleistocene surface were colonized by dense Thalassia meadows which trapped carbonate muds resulting in vertical acceration and development of the bank system. Finger coral, *Porities divaricata*, formed dense mats where tidal circulation was adequate and salinities were normal marine but were absent in the bay interior where salinities were lower. In these areas mangroves became established along bank margins.-Adapted from authors' abstract.

169. Hudson, J. H., D. M. Allen and T. J. Costello. 1970. The flora and fauna of a basin in central Florida Bay. U.S. Fish. Wildl. Serv. Spec. Sci. Rept. No. 604. 14 pp.

Monthly samples collected from a nursery area for pink shrimp, *Penaeus duorarum* in a basin in central Florida Bay (ENP), yielded 196 species of plants and animals between April 1965 and January 1968. A species list is provided. Approximately 73% of the organisms were benthic and associated with seagrass beds of *Thalassia testudinum*. The effect of different water masses on the general distribution of flora and fauna in the basin and Bay are discussed.

Study Period:April 1965-January 1968,(Biological);November 1964-January 1968 (salinity & temp.); Study Type:Qualitative; Habitat:Bank, basin, channels; Biological Component:Flora & fauna; Gear Type:Sled-net, sled-mounted suction sampler, push-net, beach seine, cast net, roller frame trawl, hand, hand net, H & L.; Temporal Frequency:Monthly; Abiotic Parameters Measured:Salinity, temp.; Dominant Taxon/Taxa Studied:*Penaeus duorarum*, *Thalassia*.

170. Hudson, J. H., G. V. N. Powell, M. B. Robblee and T. J. Smith III. 1989. A 107-year-old coral from Florida Bay: barometer of natural and man-induced catastrophes? Bull. Mar. Sci. 44:283-291.

The 107-year growth history of a massive coral, *Solenastrea bournoni*, collected in Florida Bay (ENP) during October 1986 was reconstructed using x - ray imagery from a single 10-cm core that penetrated a 1-m high colony. Growth increments totalled 952.9 mm, averaging 9 mm/yr. Growth rate trends between the Florida Bay coral and a coral (*Montastrea annularis*) of similar age from the Atlantic Ocean side of the Florida Keys indicated that both corals were rated as potential indicators of natural and man-made perturbations in years of severe environmental stress to each coral's growth rate average. A possible cause and effect relationship was found between major man-induced environmental perturbations and a reduction in growth rate in each's corals growth record.

Study Period:October 1986; Study Type:Quantitative; Gear Type:10-cm dia. cores; Number of Stations:2; Habitat:Bedrock; Biological Component:Hermatypic coral; Abiotic Parameters Measured:Water depth; Dominant Taxon/Taxa Studied: *Solenastrea bournoni*.

171. Hughes, D. A. 1969. Evidence for the endogenous control of swimming in pink shrimp, *Penaeus duorarum*. Biol. Bull. 136:398-404.

In this study current chamber experiments were conducted on the endogenous control of swimming in juvenile pink shrimp collected from the Buttonwood Canal on ebb tides during different times of the night. It was found that a predictable relationship occurred between the tide cycle to which the shrimp were exposed prior to capture and their subsequent swimming in the laboratory. Downstream swimming, which in nature occurs only on ebb tides and facilitates the offshore movements of juveniles, occurred in the laboratory only at the time of ebb tides in nature. It did not occur at the time of all ebb tides, but only during those of the early evening.

Study Period:Mid-summer, 1967; Study Type:Quantitative; Habitat:Canal; Gear Type:Plankton net; Number of Stations:1; Biological Component:Decapod crustacea; Abiotic Parameters Measured:Tidal period, moon phase; Dominant Taxon/Taxa Studied:*Penaeus duorarum*.

172. Hughes, D. A. 1968. Factors controlling emergence of pink shrimp (*Penaeus duorarum*) from the substrate. Biol. Bull. 134:48-59.

An examination of the mechanisms controlling the emergence of pink shrimp, *Penaeus duorarum* from the substrate at sunset was conducted in shrimp collected from the Buttonwood Canal (ENP). Controlled laboratory experiments indicated that emergence and subsequent activity were under rhythmic control. A resynchronization of the rhythm phase resulted from shifting the light-dark cycle, suggesting that the light-dark cycle or some associated factor is the mechanism for emergence. The effect of feeding rhythm and shrimp size on emergence was also discussed.

Study Type:Quantitative; Habitat:Canal; Number of Stations:1; Biological Component:Decapod crustacea; Dominant Taxon/Taxa Studied:*Penaeus duorarum*.

173. Hughes, D. A. 1969. On the mechanisms underlying tide-associated movements of *Penaeus duorarum*. FAO Fish. Rept. 57(3):867-874.

Studies were made on the mechanism by which postlarval *Penaeus duorarum* move inshore to nursery grounds on flood tides and juveniles move offshore on ebb tides in the estuaries of ENP. Using shrimp collected from the Buttonwood Canal, postlarvae were found to respond to decreased salinity by moving to the substrate where they remain inactive and thereby avoid displacement by the ebb tide. When the salinity increased on the flood tide, the postlarvae moved into the water column where they were transported inshore. Juveniles were found to be positively rheotactic during salinity increases (flood tide) and negatively rheotactic during decreases (ebb tide) thereby resisting inshore transport and enhancing offshore displacement. The effects of salinity on tide associated migrations of postlarval and juvenile shrimp may explain the positive correlations between the quantity of rainfall in nursery areas and the commercial catch of the following year.

Study Type:Quantitative; Habitat:Canal; Gear Type:Plankton-nets (Discovery type); Number of Stations:1; Biological Component:Decapod crustacea; Abiotic Parameters Measured:Salinity; Dominant Taxon/Taxa Studied:*Penaeus duorarum*.

174. Hughes, D. A. 1972. On the endogenous control of tide-associated displacements of pink shrimp, *Penaeus duorarum* Burkenroad. Biol. Bull. 142:271-280.

Shrimp from the Buttonwood Canal (ENP) were collected to study larval movement from the offshore spawning sites to inshore nursery areas. Results indicated that displacement behavior is under endogenous control. Laboratory studies showed that both swimming direction and velocity were effected by the tide cycle in the collection area of the previous day.

Study Type:Quantitative; Gear Type:Discovery plankton net; Number of Stations:1; Biological Component:Decapod crustacea; Abiotic Parameters Measured: Temperature, current velocity; Dominant Taxon/Taxa Studied:*Penaeus duorarum*.

175. Hughes, D. A. 1969. Responses to salinity change as the tidal transport mechanism of pink shrimp, *Penaeus duorarum*. Biol. Bull. 136:43-53.

Studies were carried out to determine the effects of salinity on the tidal transport mechanism of shrimp collected in the Buttonwood Canal. In the laboratory salinity changes were imposed on both postlarvae and juveniles. Juveniles which were positively rheotactic would become negatively rheotactic with a decrease in salinity, resulting in active downstream swimming. Shrimp could perceive differences in salinity as small as 1 ppt. In nature juveniles would swim against the current in an offshore direction while postlarvae would be displaced shoreward. Following a decrease in salinity (ebb tides), juveniles would again be displaced in an offshore direction and the postlarvae would sink to the bottom to avoid low salinities.

Study Type:Quantitative: Habitat:Canal; Gear Type:Discovery plankton net; Number of Stations:1; Biological Component:Decapod crustacea; Abiotic Parameters Measured:Salinity, current, tidal flow, light; Dominant Taxon/Taxa Studied:*Penaeus duorarum*.

176. Idyll, C. P. 1965. Shrimp need freshwater too. Nat. Parks Mag. Oct. :14-15.

This paper reports on the effects of the lack of fresh water in ENP on the offshore shrimp industry at the Tortugas Grounds in the Gulf of Mexico. The needs of the shrimp industry can be summarized by three questions dealing its economic value, the relationship of shrimp taken commercially offshore and those in ENP, and of water shortages in ENP on pink shrimp populations. Shrimp life cycles, invasions by marine predators, migrations, salinity relationships, food abundances, and estuarine productivity are considered. The author concludes that a large shrimp fishery population can only be supported by a brackish estuary which requires large supplies of fresh water.

Study Type:Review, qualitative.

177. Idyll, C. P., E. S. Iversen and B. J. Yokel. 1965. Abundance of pink shrimp on the Everglades National Park nursery grounds. U.S.Dept. Inter., Fish & Wildl. Serv., Circ. No. 230, 28-29.

No abstract available.

178. Idyll, C. P., E. S. Iversen and B. J. Yokel. 1968. Variations in abundance of juvenile pink shrimp emigrating from the Everglades National Park, in relation to the commercial catch. U.S. Fish Wildl. Serv. Circ. No. 295. p. 13-14.

Sampling procedures for juvenile pink shrimp in the Buttonwood Canal have changed. Wing nets are currently used as opposed to channel nets which allow for the establishment of an additional site at Joe River. Comparisons of size and abundance were made at the two sites and together were compared with the commercial catch at the Tortugas Grounds. Environmental factors are compared with channel net catches in the Buttonwood Canal.

Study Period:1966; Habitat:Canal, river; Gear Types:Wing/channel nets; Number of Stations:2; Biological Component:Decapod crustacea; Abiotic Parameters Measured:Salinity, temperature; Dominant Taxon/Taxa Studied:Pink shrimp, *Penaeus duorarum*.

179. Idyll, C. P., E. S. Iversen and B. J. Yokel. 1969. Variations in abundance of juvenile pink shrimp emigrating from the Everglades Naticnal Park estuary, in relation to the commercial catch. U.S. Fish Wildl. Serv., Circ. No. 325, P. 14.

This report examines the abundance of juvenile pink shrimp emigrating from the Buttonwood Canal and the Joe River area in ENP. It was determined at the Buttonwood Canal station that a decline in abundance of shrimp from 1965 to 1967 agreed with the index of abundance established for the smallest shrimp caught commercially. Although a positive correlation was found to exist in the trends of relative abundance, considerable variation was noted to be introduced because of the wide size range of the immigrants in most months and the apparent differences in the amount of time required for large shrimp to be recruited into the fishery compared to the time required for the smaller shrimp. At the Joe River site, periods of high relative abundance were seen in June and September in 1966 and 1967. Considerable variation was also found in the relation between relative abundance and the commercial index.

Study Period:30 months; Study Type:Quantitative; Habitat:Water column; Biological Component:Decapod crustacea; Gear Type:Wing net; Temporal Frequency:Bi-weekly; Abiotic Parameters Measured:Salinity, temp., current velocity, moon phase; Dominant Taxon/Taxa Studied:Pink shrimp, *Penaeus duorarum*.

180. Idyll, C. P. and M. A. Roessler. 1968. Seasonal changes in relative abundance of postlarve of pink shrimp entering the Everglades estuary. U.S. Fish Wildl. Serv. Circ. No. 295. p. 12-13.

Sampling of postlarval pink shrimp populations continued during 1966 at Buttonwood Canal & Little Shark River, ENP. Abundance was highest during new & first quarter moon at both sites in July. Measurements of salinity in the field were modified and environmental effects on size were examined.

Study Period:1966; Habitat:Water column; Gear Type:Plankton net (471 mm mesh); Number of Stations:2; Biological Component:Decapod crustacea; Abiotic Parameters Measured:Salinity, temp., current, tidal flow; Dominant Taxon/Taxa Studied:Pink shrimp, *Penaeus duorarum*.

181. Idyll, C. P. and B. J. Yokel. 1970. The growth and distribution of juvenile pink shrimp in the estuaries of Everglades National Park. U.S. Fish. Wild. Serv. Circ. 343. pgs 16-21.

Studies were begun on growth and distribution of pink shrimp in Whitewater-Coot Bay estuary during 1968. Monthly roller trawl sampling conducted during 1968-69 at eight sites showed significant differences in abundance among stations and months. Growth was studied using 20,000 postlarvae stocked in enclosures and sampled weekly. Growth was followed for 24 weeks. Measurements of salinity and temperature were made during the period. Growth was faster in summer.

Study Period:September 1968-April 1969; Study Type:Quantitative; Habitat:Open water/basin; Temporal Frequency:Abundance-monthly, growth-weekly; Abiotic Parameters Measured:Salinity, temperature;Biological Component:Decapod crustacea; Dominant Taxon/Taxa Studied:Pink shrimp, *Penaeus duorarum*.

182. Iversen, E. S. and D. C. Tabb. 1962. Subpopulations based on growth and tagging studies of spotted seatrout, *Cynoscion nebulous*, in Florida. Copeia 3:544-548.

Subpopulations of spotted seatrout were analyzed using growth and tagging data from several locations along the coast of Florida, including Cocoa, Flamingo (ENP), Ft. Myers, Cedar Key, & Apalachicola. Different growth rates of seatrout from these areas indicate subpopulations of this species. These findings are based on tagging results where 95% of the recaptures moved less than 30 miles from their point of release. Evidence suggesting nonmigratory movement of snook and mullet is presented. The authors conclude that for successful management the different stocks should be treated separately.

Study Period:1955-60; Habitat:Variable; Study Type:Semiquantitative; Biological Component:Sportfish; Gear Type:H & L; Dominant Taxon/Taxa Studied:*Cynoscion nebulous*.

183. Iversen, E. S. and B. J. Yokel. 1963. A myxo-sporidian (sporozoan) parasite in the red drum, *Sciaenops ocellatus*. Bull. Mar. Sci. Gulf & Carib. 13(3):449-453.

This paper presents a description of a new species of myxo-sporidian parasite located in the intestine & pyloric caeca of the red drum caught in the estuaries of ENP (Florida Bay).

Study Period:1961-62; Habitat:Variable; Study Type:Qualitative; Biological Component:Sportfish; Dominant Taxon/Taxa Studied:*S. ocellatus*.

184. Iverson, R. L. and H. F. Bittaker. 1986. Seagrass distribution and abundance in eastern Gulf of Mexico coastal waters. Estuar. Coast. Shelf Sci. 22(5):577-602.

The marine angiosperms, *Thalassia testudinum*, *Syringodium filiform*, and *Halodule wrightii*, form two of the largest reported seagrass beds along the northwest and southern coasts of Florida where they cover about 3,000 km2 in the Big Bend area and 5500 km2 in Florida Bay including the Florida Bay portion of ENP, respectively. The cross shelf limits of the two major seagrass beds are controlled nearshore by increased water turbidity and lower salinity around river mouths and offshore by light penetration to depths which receive 10% or more of sea surface photosynthetically active radiation. Seagrasses form large beds only along low energy reaches of the coast.

Study Period:October 1974-1980; Study Type:Quantitative; Habitat:Estuarine/coastal marine; Number of Stations:300 with several sites within the Florida Bay portion of ENP; Gear Type:Cores, stakes, submerged vegetation maps (see no. 242 in bibliography), aerial photography, planimetric measurement; Biological Component:Flora; Abiotic Parameters Measured:Active radiation, sediment characteristics; Dominant Taxon/Taxa Studied:*Thalassia*, *Halodule*, *Syringodium*.

185. Jannke, T. E. 1971. Abundance of young sciaenid fishes in Everglades National Park, Florida in relation to season and other variables. M.S. Thesis. Univ. of Miami, Miami, Fla. 128 pp.

Also publ. as: Sea Grant Tech. Bull. No. 11, Univ. of Miami Sea Grant Prog., Miami, Fl 1-128 p. (1971).

Studies on the abundance of 8 species of young sciaenid fishes were made for 1 year in the Little Shark River area of ENP. Seasonal abundance is shown for each of the 8 species caught. Data summaries for size frequency, catch/trip for each species and mean size calculations for the three most common species are presented. There was no relation between catch of the three most common species and salinity or temperature. Nighttime catches of spotted seatrout larvae exceeded daytime catches.

Study Period:January 1966-December 1967; Habitat:Water column; Study Type:Quantitative; Number of Stations:1; Temporal Frequency:Monthly/diel; Gear Type:1-m Plankton net (471 mm mesh); Abiotic Parameters Measured:Salinity, temperature, current velocity; Dominant Taxon/Taxa Studied:*Cynoscion nebulous*, *Bairdiella chrysoura*, *Sciaenops ocellata* (now *ocellatus*).

186. Jenkins, R. V. 1983. A comparison of Florida Bay marine banks and "rock reefs" of the Miami Limestone in the Everglades National Park. Geol. Soc. Am. Abstr. Progr. 15(1):1.

In ENP long, linear, low (0.3 m) topographic highs occur in the Pleistocene Miami Limestone. Morphologically similar features are accumulating today in Florida Bay as marine mudbanks. The origin of the "rock reefs" has been proposed as being controlled by preexisting topographic features, structurally controlled, sedimentary depositional features, or diagenetically controlled erosional features. To learn more about the "rock reefs", the mud banks in Florida Bay were studied for comparative

purposes. Significant differences in texture and grain size indicate the "rock reefs" are not sedimentary depositional features similar to the mudbanks. The reefs show no structural or topographical control. Evidence indicated the reefs are diagenetically controlled erosional features.-Adapted from author's abstract.

187. Jones, A. C., D. E. Dimitriou, J. J. Ewald and J. Tweedy. 1970. Distribution of early development stages of pink shrimp, *Penaeus duorarum*, in Florida waters. Bull. Mar. Sci., 20:634-661.

Larval stages of pink shrimp were collected by plankton nets from the Tortugas Shelf and Florida Bay (NW Florida Bay in ENP) from 1959 to 1962. Protozoeae and myses were distributed on the shelf mainly between the 8- and 30-fathom depth contours. Postlarvae were found both on the shelf and also in the shallower waters of Florida Bay. Older postlarvae stages were almost entirely restricted to inshore waters primarily at two stations which were close to the Shark River and Flamingo in ENP (the two principal entrances to Whitewater Bay, a major nursery area for the Tortugas stock of pink shrimp). Pink shrimp spawned throughout the year but the intensity of spawning was low in winter. Variability of the net catches and vertical migration routes of the larvae to the inshore area are hypothesized.

Study Period:January 1959-July 1962; Study Type:Quantitative: Habitat:Offshore, inshore water column, canal; Gear Type:Discovery plankton nets; Number of Stations:Offshore-up to 20, inshore-Buttonwood Canal, Florida Keys-channels; Temporal Frequency:Monthly/irregular; Biological Component:Decapod crustacea: Abiotic Parameters Measured:Water temp., salinity, flow, water depth; Dominant Taxon/Taxa Studied:*Penaeus duorarum*.

188. Jones, J. I., R. E. Ring, M. O. Rinkel and R. E. (eds) Smith. 1973. A summary of knowledge of the eastern Gulf of Mexico. St. Univ. Sys. of Fla., Inst. of Oceanogr (SUSIO), Gainesville, Fl.

This report represents a compilation and evaluation of selected studies of the significant natural and artificial environmental characteristics of the eastern Gulf of Mexico and provides an overview of the current status of knowledge and information on past and on-going studies which are significant for a more complete understanding of the environment and ecology of the area. An extensive geological literature has been developed in this region since it is one of the major petroleum producing regions of the world and since a number of major commercial fisheries are located in this region there is an extensive literature regarding this aspect as well. Some of the more general statements made on the major topics addressed in this report are briefly summarized as follows: the climate of the report area is characterized by a subtropical high-pressure belt, with the period from March to September characterized by a clockwise atmospheric circulation pattern; wind and waves respond to seasonal changes in circulation patterns. Effects of hurricanes, tropical storms, and winter cold fronts are also discussed. Sections discussed as they pertain to the Everglades region include extensive chemical data on nearshore and estuarine waters including water quality, nutrients, minor elements and their hydrology are presented. A discussion of the biological environment is presented relative to both the environment and organism including salt marshes, mangroves,

seagrass beds, plankton, major benthic invertebrate groups, fishes, marine mammals and birds. The Ten Thousand Island - Florida Bay area is considered as one of the most complex coastal areas in the United States.

Study Type:Qualitative, review -physical, chemical, hydrological, biological, environmental quality, and recreation.

189. Kerr, S. D., Jr. 1972. Patterns of coastal sedimentation: carbonate muds of Florida Bay. Bull. Am. Assoc. Petrol. Geol. 56(3):632. (Abs.).

The accumulation of carbonate muds into distinct sedimentary patterns within the Florida Bay portion of ENP was investigated. The physiography of the accumulation was determined by hydrological processes which also regulate local faunal distributions. Circular lakes of deeper water surrounded by banks and islands dominate the physiography of the Bay. The banks are largest in the western bay while the NE segment is characterized by narrow banks. Circular patterns in sediment distribution suggests that significant currents develop in all directions. The historical formations of sedimentary patterns was also examined.-Adapted from author's abstract.

190. Kick, R. 1981. Carbonate sediments from Peterson Key Bank, Florida Bay. M.S. Thesis, Univ. of South Florida, Tampa.

A study of carbonate sediments at Petersen Key Bank, Florida Bay (ENP), demonstrated that all sediments are of biological origin, produced predominantly by molluscs, *Halimeda*, and foraminifera. Difference in sediment texture was attributed to the mode of sedimentary breakdown by organisms. These organisms and the type of sediment they produce are summarized. The distribution of sediment type was used to determine the recent history of two channels in the bank.

Study Type:Quantitative; Habitat:Bank (mud,sand,rock); Biological Component:Mollusca, foraminifera; Gear Type:Piston corer; Number of Stations:2; Abiotic Parameters Measured:Sediment grain-size, depth; Dominant Taxon/Taxa Studied:*Halimeda*, *Pencillus*.

191. Kilby, J. D. and D. K. Caldwell. 1955. A list of fishes from the southern tip of the Florida peninsula. Quart. J. Fla. Acad. Sci. 18:195-206.

Thirty-eight species of fish including some that are usually marine were collected from the southern tip of Florida, mostly within the future boundaries of ENP. Of the 24 stations sampled, 5 were sited in the extreme northern Florida Bay/Everglades estuaries. A brief annotated checklist of fishes and station descriptions along with salinity measurements are provided.

Study Type:Qualitative; Habitat:Variable, mostly estuarine; Number of Stations:24; Biological Component:Fish; Temporal Frequency:Once; Abiotic Parameters Measured:Salinity; Dominant Taxon/Taxa Studied:Marine (mojarra, *E. gula*, needlefish, *Stronglura* spp., silversides, mullet, pinfish, *L. rhomboides*).

192. King, C. A. 1987. Organochlorines in Bottlenose dolphins, (*Tursiops truncatus*) and Pygmy sperm whales (*Kogia breviceps*) from southeastern Florida. M.S. Thesis, Univ of Miami, Coral Gables, Fla.

Melon tissue samples from 15 bottlenose dolphins, *Tursiops truncatus*, and 18 pygmy sperm whales strandings from southeastern Florida were analyzed for chlorinated pesticides and PCBs. Results indicated that bottlenose dolphins had significantly higher concentrations of chlorinated pesticides and PCBs than pygmy sperm whales, as predicted by distribution and diet. When compared to levels of PCBs and DDT previously reported in odontocetes, concentrations of DDT in pygmy sperm whales and bottlenose dolphins in the present study are within the low range of global contamination. Concentrations of PCBs in dolphins were within the high range.-Adapted from author's abstract.

193. King, J. E. 1949. A preliminary report on the plankton of the west coast of Florida. Quart. J. Fla. Acad. Sci. 12(2):109-137.

As part of a comprehensive program started in 1948, on the causes of the outbreaks of a dinoflagellate, *Gymnodinium brevis*, in the Gulf coastal waters of southwest Florida, a preliminary study on the planktonic forms characteristic of this area was undertaken. In addition to the established stations near the Boca Grande area, trips were made to other parts of the coast including the mouth of the Shark River in ENP. It was found that although the abundance of plankton was not great, it consisted of an exceedingly varied flora and fauna with the dominant forms being diatoms and copepods. Future studies will address seasonal cycles, succession, and relationships of dinoflagellates with biological, chemical or physical changes in the Gulf waters.

Study Period:January- October 1949; Study Type:Quantitative; Habitat:Coastal marine; Number of Stations:20 (1 in ENP); Gear Type:Plankton sampler (Clarke-Bumpus); Biological Component:Flora & fauna; Abiotic Parameters Measured:Salinity, depth; Dominant Taxon/Taxa Studied:Diatoms, copepods.

194. Klukas, R. W. 1967. Factors affecting nesting success of loggerhead turtles at Cape Sable, Everglades National Park. Open File Rept. No. N1415. 58 P. (Mimeo), ENP, Homestead, Fla.

Efforts were initiated in spring 1966 to reduce the racoon population at Cape Sable by trapping in one area and setting aside another area in the rookery as a control area where no trapping was conducted. A comparison of the nesting success in the two areas indicated that live-trapping can be a very effective technique in controlling and reducing the amount of nest predation by racoons. Additional notes on the nesting success and behavior of loggerhead turtles nesting there, and data on the natural history of racoons near the rookery are provided.

Study Period:March-August 1966; Study Type:Qualitative, quantitative; Gear Type:traps, holding pens, nest boxes & stakes, on-ground observations; Habitat:Beaches, mangroves; Dominant Taxon/Taxa Studied:*Caretta caretta*.

195. Knight, C. D. 1988. Mechanical compaction of Recent carbonate sediments in Florida Bay. The Compass 65(2):111-115.

The sedimentary features recognized in ancient fine-grained limestone were produced by mechanical compaction from a core taken on Cross Key bank, Florida Bay, ENP. These features included: (1) reduction of sediment thickness by 40-50%, (2) creation of organic layers that mimic styloties, (3) obliteration of identifiable marine grasses, (4) creation of packstone layers, and (5) reorientation of fossils toward the horizontal. The end product was an artificial rock that resembled a biomicritic limestone.

Study Type:Quantitative:Habitat:Mud bank; Gear Type:Core; Number of Stations:1; Biological Component:*Thalassia* rhizomes; Abiotic Parameters Measured:Sediment characteristics.

196. Knight, C. D. 1988. Pore-fluid chemistry of selected carbonate mudbanks and mangrove-fringed islands, Florida Bay. M.S. Thesis, Wichita State Univ., Wichita, Kans. 238 pp.

By comparing the Bay water and carbonate interstitial pore-fluid Ca/Cl, Mg/Cl, and Sr/Cl ratios it was possible to infer if diagenesis was occurring in selected carbonate mudbanks (Cross and Crab Key Bank) and mangrove-fringed islands (Bald Eagle and Crane Key) within Florida Bay (ENP). The bulk of the mudbank aragonite and high Mg calcite sediments have undergone little diagenetic change while the Bald Eagle pore-fluid ratios indicated that high-Mg calcite sediments have started to convert to low-Mg calcite with incipient phreatic cementation within the upper 1-3 ft. Both the mudbank and island interstitial pore-fluids are supersaturated with calcite and aragonite and can be attributed to the reduction of sulfate by bacteria. Sedimentary features produced by the mechanical compaction of a Cross Bank core were discussed.

Study Type:Quantitative; Gear Type:Soft-sediment coring device; Number of Stations:22 core sites; Abiotic Parameters Measured:Salinity, pH, alkalinity, Ca, Mg, Na, K, Sr, $SO_4$, sediment characteristics.

197. Kolipinski, M. C., H. Klein and A. L. Higer. 1967. Field guidebook on geology and ecology of Everglades National Park. Miami Geol. Soc., Miami, Fla. 28 pp.

This field trip guidebook summarizes the geology and ecology of ENP with emphasis on the Whitewater Bay - Shark River estuary and upper Florida Bay from various publications compiled to complement a carbonate field course taught by the senior author. Also, a list of field stops are provided with brief ecological descriptions of each site. Provisional water quality measurements from the Shark River are given for the period of November through December 1966.

Study Period:1962-1966; Study Type:Summary/review/qualitative.

198. Kushlan, J. A. and F. J. Mazzotti. 1989. Historic and present distribution of the American crocodile in Florida. J. Herp. 23:1-7.

The historic and recent distribution of the American crocodile in Florida is from Vero Beach and Tampa south to the lower Florida Keys. Its nesting distribution is southern Biscayne Bay and northeastern Florida Bay (ENP). Both distributions reflect winter temperature. A westward addition to the nesting range in Florida Bay was observed which compensated for the loss of habitat on Miami Beach and the upper Florida Keys. Except for the shift in nesting away from developed areas, the distribution of this species in Florida is the same as that historically documentable.

Study Period:1977-1980; Study Type:Qualitative; Gear Type:Field observation-Boat/canoe/aircraft/on foot,historical documentation-ENP files, pers. comm., publ. liter. Temporal Frequency:Monthly/irregular; Biological Component:Marine reptile; Dominant Taxon/Taxa Studied:American crocodile.

199. Kushlan, J. A. and F. J. Mazzotti. 1982. Population biology and status of the American crocodile in south Florida. Pgs. 188-194 IN: D.Dietz & F.W. King (eds.), Crocodiles. Gland, Switzerland IUCN.

The population biology and status of the American crocodile was studied in Florida Bay, ENP during 1977-1982. In this paper the authors briefly abstract some new findings concerning various hypotheses previously suggested to account for presumed population decreases.Data is summarized on historic population status, current population size and structure, nesting biology, habitat, mortality as well as management needs which suggest that current population is not decreasing, although its historic range has decreased somewhat. The authors see no need for any drastic manipulative management of the south Florida crocodile population.

Study Period:1977-1982; Study Type:Summary review; Biological Component: Marine reptile; Dominant Taxon/Taxa Studied:American crocodile.

200. Kushlan, J. A. and F. J. Mazzotti. 1989. Population biology of the American crocodile. J. Herpetol. 23:7-21.

The population biology of the American crocodile (*Crocodylus acutus*) was studied in southern Florida, mainly within the northeastern portion of Florida Bay, ENP, during 1977-1982. Crocodiles occur primarily in inland mangroves protected from wave action. Females use the open waters of Florida Bay only for access to nesting sites. Individuals have large (86-262 ha), overlapping activity areas. Nesting occurs in spring and summer. Clutches averaging 38 eggs were laid both in holes and mounds in the ground. It was found that the number nests have not declined in recent years. Hatchling failure occurred as a result of infertility, predation, and embryonic mortality. Seventy-eight percent of nests hatched some young. All expected age classes occurred in the population. At least 45 crocodiles have been released into southern Florida in 17 years. The authors estimate the southern Florida population to be about 220 $\pm$ 78 adults and subadults.

Study Period:1977-1982; Study Type:Quantitative, qualitative; Gear Type:Field observations-Boat/aircraft/canoe, capture technique-hand/neck noose, radio transmitters; Habitat:Marsh, Mangrove swamp-pools/lakes/creeks/flats, Florida Bay (nearshore) beaches; Biological Component:Marine reptile; Abiotic Parameters Measured:Air & water temp., salinity, wave action, water level & depth; Dominant Taxon/Taxa Studied:American crocodile.

201. Kushlan, J. A., S. A. Voorhees, W. F. Loftus and P. C. Frohring. 1986. Length, mass, and calorific relationships of Everglades animals. Fla Sci. 49(2):65-79.

Meristic and calorific relationships for large sample sizes of aquatic animals in the Everglades and estuarine habitats of southern Florida were determined. From 1977-1981 over 70,000 aquatic animals were collected mostly within the boundaries of ENP. The relationships derived included wet mass to length (52 species, 2 families), dry mass to length (17 species), dry mass to wet mass (17 species), and calorific values (44 taxa). The analyses presented is reported to be the first available for most of the species. The authors suggest that these relationships can be used in estimating standing stock and energy flow in aquatic systems.

Study Period:1977-1981; Study Type:Quantitative; Biological Component:Fauna (fishes, amphibians, invertebrates); Habitat:Marshes, estuaries; Gear Type:Throw-traps, electrofishing, rotenone, nets (seine, cast, gill, & dip nets); Dominant Taxon/taxa Studied:Marine fish including *E. gula, L. rhomboides, B. chrysoura, H. plumieri.*

202. Larson, D. K. and A. P. Ramus. 1984. Distribution of caridean shrimp (Decapoda): Natantis; Caridea) in the shallow waters of western Florida Bay. Fla. Sci. 47(Suppl. 1):20. (Abs.).

Since November 1983, caridean shrimp were collected from $M^2$ quadrats in shallow seagrass habitat bordering mangrove islands of Johnson Key Basin (ENP). Species richness, distribution and abundance were determined. Of the six species collected, *Thor floridanus*, *Hippolyte pleuracanthus*, and *Palaemonetes intermedius* were the dominants. *Tozema carolinease* were observed to increase at offshore sites dominated by *Thalassia testudinum.* Preliminary results indicate the greatest species richness and peak abundance (as high as 322 shrimp/$M^2$) occur at the *Halodule wrightii* and *Thalassia* transition zone.-Adapted from authors' abstract.

203. Layman, J. W. 1977. Acid insoluble residues of the carbonate sediments of northwest Florida Bay, South Florida. M.S. Thesis, Univ of Toledo, Toledo, Ohio.

Sixty-seven surface grab and core samples, collected during the summer of 1976 from the carbonate sediment forming environment of northwest Florida Bay (ENP), were analyzed to determine the amounts, composition, textures and sedimentation patterns of acid insoluble residues. The characteristics of the acid insoluble residues and their sedimentation patterns were then related to ten depositional sub-environments including tidal channels, mud banks, and the mainland shore, each of which were determined and classified by depth of water, tidal activity, and exposure to wave action. Quartz, the dominant constituent of the acid insoluble residue, ranged in size from 0.0 to 8.0 phi; sponge spicules from 1.5 phi (350 microns) to 8.0 phi (4 microns), and, radiolaria were present in minor amounts and ranged in size from 3.0 to 6.0 phi. Quartz is transported into northwest Florida Bay by longshore and flood tidal currents while sponge spicules and radiolaria are derived mostly from within the study area.

Study Period:Summer 1976; Study Type:Qualitative, quantitative; Gear Type:Ponar grab, cores; Number of Stations:67; Habitat:Water column, sediment; Abiotic Parameters Measured:Water depth, sand, acid insoluble residues (quartz, sponge spicules, radiolarians).

204. Ledder, D. A. 1987. Food habits of the West Indian Manatee, *Trichechus Manatus* Latirostris, in south Florida. M.S. Thesis, Univ of Miami, Coral Gables, Fla.

Studies on the food habitats of 84 West Indian manatee, *Trichechus manatus*, collected in south Florida waters showed that the most important food items in salt water were seagrasses, *Halodule*, *Syringodium*, and *Thalassia* while Hydilla were consumed in greatest quantities in fresh water. Eleven animals were examined from the west coast of ENP. The results indicate that manatees demonstrate a generalist feeding strategy, utilizing foods of high abundance, but of low nutritional value. In salt water it feeds extensively on seagrasses, yet it can subsist entirely on fresh water aquatics, suggesting that the manatee is an opportunistic herbivore.

Study Period:1977-1981; Study Type:Qualitative, quantitative; Habitat:Inshore; Dominant Taxon/Taxa Studied:*Trichechus manatus*.

205. Lee, C. C. 1969. The decomposition of organic matter in some shallow water, calcareous sediments of Little Blackwater Sound, Florida Bay. Ph.D. Dissertation, Univ. of Miami, Miami, Fla. 106 pp.

The organic matter deposited in recent calcareous sediments as well as its rate of biochemical change was examined based on the study of 9 cores from Little Blackwater Sound, Florida Bay, ENP. The results of an analysis for pH, Eh, moisture, carbonate carbon, TOC, and lipid carbon were correlated with various environmental sediment parameters. It was determined that sediments contained two different distributions of organic carbon which increased with sediment depth. Concentrations for lipids, fatty acids, $C_{16}$ & $C_{18}$ acids are discussed. It was concluded from degradation studies that the processes of organic matter degradation were cyclic and microbial in nature.

Study Period:February-March 1966; Study Type:Quantitative; Habitat:Basin sediments (mud); Gear Type:Punch corer; Number of Stations:9; Number of Replicates/Stations:2; Abiotic Parameters Measured:Water temperature, salinity, Eh, pH, water content, sediment composition.

206. Lidz, B. H. and P. Rose. 1989. Diagnostic foraminiferal assemblages of Florida Bay and adjacent shallow waters: a comparison. Bull. Mar. Sci. 44(399-418).

Ecologic studies of benthic foraminifera in Florida Bay (ENP), indicate that: (1) the bay is a specialized restricted platform interior environment; (2) its fauna is divisible into three subfaunas: nearshore, mudbank, and "lake"; (3) substrate, currents, wave intensity, and wave direction affect local distribution but do not alter regional patterns; and (4) faunal assemblages rather than individual species of foraminiferal are diagnostic environmental indicators as many species range over several faunal zones. Foraminiferal biostratigraphy on a platform, whether modern

or ancient, should involve determination of ecologic patterns of family distribution, similarities of test structure, ratios between faunal groups, and general trends of populations.

Study Type:Quantitative; Number of Stations:46; Gear Type:Hand; Habitat: Mudbank; Biological Component:Fauna; Abiotic Parameters Measured:Sediment characteristics.

207. Lindall, W. N.,Jr., W. A.,Jr. Fable and L. A. Collins. 1973. Range extension of *Centropristis striata melana*. Fla. Sci. 36(2-4):214-215.

Two juveniles of *Centropristis striata melana* were collected off the mouth of the Harney River in ENP on November 3, 1971. This collection extends the known range of *C. striata* some 100 miles southward.

Study Period:1971; Study Type:Qualitative; Gear Type:Otter trawl; Habitat:Water column; Biological Component:Water column fish; Abiotic Parameters Measured: Salinity, temperature, DO;Dominant Taxon/taxa Studied:*Centropristis striata melana*.

208. Lindall, W. N.,Jr., J. R. Hall, W. A.,Jr. Fable and L. A. Collins. 1974. Fishes and commercial invertebrates of the nearshore and estuarine zone between Cape Romano and Cape Sable, Florida. NTIS PB235-215.

This study was designed to acquire baseline data on fishes and commercial invertebrates inhabitating the estuarine and nearshore waters between Cape Romano and Cape Sable (ENP). An annotated list of fishes with environmental data where each species was collected is provided. Results show that nearly that 32,000 finfishes representing 114 species were collected, quarterly, between May 1971 and February 1972. The most abundant species, in decreasing order of abundance, were the striped anchovy, *Anchoa hepsetus*; bay anchovy, *Anchoa mitchilli*; silver jenny, *Eucinostomus gula*; fantail mullet, *Mugil trichodon*; and pinfish, *Lagodon rhomboides*. Of the six species of commercial invertebrates collected, pink shrimp, *Penaeus duorarum*, comprised nearly 91% of the total numbers of individuals taken (2,800). The number of organisms offshore increased with proximity to the shoreline. Generalized locations of isohalines for each quarter are also provided.

Study Period:May 1971-February 1972; Study Type:Qualitative; Gear Type:16' otter trawl, 100' beach seine, Petersen grab; Number of Stations:Inshore (11), offshore (24, 8 transects/3 sites each); Temporal Frequency:Quarterly; Number of Replicates/Station:One per gear type; Habitat:Water column and hard/soft bottom; Biological Component:Water column and bottom fishes; Abiotic Parameters Measured:Salinity, temperature, DO, depth, sediment; Dominant Taxon/Taxa Studied:*Anchoa hepsetus, Anchoa mitchilli, Eucinostomus gula, Penaeus duorarum*.

209. Lindberg, S. E. 1974. Mercury in interstitial solutions and associated sediments from estuarine areas on the Gulf of Mexico. M.S. Thesis. Fla. State Univ., Tallahassee. 127 pp.

This study, conducted in the Everglades (Chokoloskee Bay, ENP) and Mobile Bay, Alabama to determine the concentrations of mercury in sediments and interstitial water, showed that mercury content was closely related to organic levels. Although the Chokoloskee Bay samples had higher absolute levels of mercury than Mobile Bay samples, when normalized to the organic content of the sediment, Mobile Bay had higher relative mercury concentrations. Also, the effect of resuspended sediments on the mobility of sedimentary and interstitial mercury was discussed and mechanisms of mercury incorporation into sediment and interstitial water were proposed.

Study Type:Quantitative; Gear Type:Piston corer; Number of Stations:2; Abiotic Parameters Measured:Mercury content, organic content, pH, Eh.

210. Lindberg, S. E. and R. C. Harriss. 1974. Mercury-organic matter associations in estuarine sediments and interstitial water. Envir. Sci. Technol. 8:459-462.

Sediment samples from ENP (Chokoloskee Bay) and Mobile Bay, which receives anthropogenic mercury effluents, were analyzed for mercury and dissolved organic carbon. Significant associations between sediment Hg and sediment organic matter and between dissolved interstitial Hg and dissolved organic carbon were found. Mercury in sediments and interstitial water occurs at higher concentrations in the Everglades than in Mobile Bay. When normalized to organic content of the sediment or dissolved organic carbon concentration in pore water, higher relative mercury concentrations were shown to occur in Mobile Bay.

Study Type:Quantitative; Habitat:Estuarine/coastal marine mud; Abiotic Parameters Measured:Salinity, DOC, Hg; Number of Stations:2 (1 in ENP); Number of Replicates/Station:1; Gear Type:Piston-fitted tube.

211. Livingston, R. L. 1989. Ecosystem research and resource management: application to Florida Bay. Bull. Mar. Sci. (Abstract). 44:517.

There are three basic components concerning research that is ultimately to be used for management purposes: 1) the design of a interdisciplinary research product; 2) adequate computational facilities for continuous analysis of data; and 3) the application of the results to management problems. There is considerable disagreement and controversy concerning how to carry out comprehensive, interdisciplinary programs that are designed to generate information that can ultimately form the basis of predictive models. Most ecosystem research is carried out in patchwork-quilt fashion, with 6 months of data here, 12 months of data there, in the hope that, someone can stick it all together and make sense out of the results. In terms of money and time spent for research, the patchwork-quilt approach is both inefficient and scientifically unsatisfactory, encouraging the mindless generation of monitoring data. There is ample evidence that the patchwork-quilt proponents are in part responsible for the wholesale deterioration of natural ecosystems, both in Florida, a rapidly developing state, and the nation as a whole. The reason is that, although a scientific database by itself, cannot solve the important environmental problems of the world, without such data and an enlightened use of the results, habitat deterioration becomes a certainty.- Adapted from author's abstract.

Study Type:Review.

212. Lloyd, R. M. 1960. Shell chemistry of some Recent and Pleistocene mollusks and its environmental significance. Geol. Soc. Am. Bull. 71(12):1917. (Abs.).

In this study Florida Bay (ENP) is used as a model to show how climatic, geographic, and hydrographic factors can influence the oxygen 18/oxygen 16 and carbon 13/carbon 12 ratios and the Sr/Ca and Mg/Ca ratios of shallow-shelf marine waters. Water chemistry variations are reflected in variations in the chemistry of mollusk shells collected in the Bay. The gradient of $H_2O^{18}$ in the water is clearly reflected in a similar gradient in the carbonate oxygen of mollusk shells. Results indicate that the present environmental framework of the Bay has existed for the last 3700 years and that part of it is derived from the Florida mainland.- Adapted from author's abstract.

213. Lloyd, R. M. 1964. Variations in the oxygen and carbon isotope ratios of Florida Bay mollusks and their environmental significance. J. Geol. 72(84-111).

The factors of climate and geography which produce salinity gradients and affect the molluscan fauna distribution in Florida Bay (ENP), also cause variations in the isotopic composition of Bay water. The isotopic composition of Bay water varies in response to (1) mixing of Atlantic and Gulf of Mexico waters having a relatively constant isotopic composition with Bay water along the western and southeastern margins; (2) evaporation of Florida Bay water which causes isotopic enrichment over the entire Bay; and (3) the introduction of isotopically enriched fresh water along the northern margin of the Bay. These processes produce a persistent gradient of increasing isotopic composition from south to north in the bay water while water outside the Bay is maintained at a lower and more constant isotopoic composition. Results indicate that isotopic ratios from eight species of mollusks reflect clearly the sharp contrast between Bay and open water isotopic compositions. Measurement of carbon isotopic ratios in Florida Bay mollusk shells reveals a gradient of decreasing carbon isotopic composition going from open-shelf water into the Bay.

Study Period:1958-1959; Study Type:Quantitative; Habitat:Water column, banks, basins; Number of Stations:32 (20 in and /or adjacent to Bay waters; Biological Component:Mollusks; Temporal Frequency:Monthly; Gear Type:Screen; Abiotic Parameters Measured:Salinity, temperature; rainfall, isotopic composition; Dominant Taxon/Taxa Studied:*Anomalocardita cuneimeris*, *Modulus modulus*, *Bulla occidentalis*.

214. Loftus, W. F. 1987. Possible establishment of the Mayan cichlid, *Cichlasoma urophthalmus* (Gunther) (Pisces: Cichlidae), Everglades National Park, Florida. Fla. Sci. 50(1):1-6.

The first U.S. collections of the Mayan cichlid, *Cichlasoma urophthalmus*, a native of Central America, were made during January 1983 in the Taylor Slough, a drainage basin of the Florida Bay estuary (ENP). Two populations were found; a larger one in an estuarine creek where spawning was observed, and a smaller one in a strictly freshwater habitat (Anhinga Pond). Establishment of *C. urophthalmus*

was based on spawning activity, wide range of specimen lengths, and a persistence in park waters for three years. It was suggested that the Mayan Cichlid may become a permanent member of Florida's ichthyofauna; the source of the introduction remains unknown.

Study period:Fall 1983-summer 1985; Study Type:Qualitative; Habitat:mangrove creek, borrow ponds; Number of Stations:16; Number of Replicates/Station: 1-many; Gear Types:Electrofishing, rotenone, seines, Hook & line; Biological Component:Fish (exotic); Abiotic Parameters Measured:Salinity, temperature; Dominant Taxon/Taxa Studied:Mayan cichlid, *Cichlasoma urophthalmus*.

215. Ludwig, G. M., J. E. Skjeveland, N. A. Funicelli, H. E. Bryant, D. A. Meineke, L. J. Mengel and M. R. Dewey. 1989. Survival of Florida Bay fish tagged with internally anchored spaghetti tags. Bull. Mar. Sci. (Abstract). 44:518.

Experimental studies to determine the short term survivability of tagged white (*Mugil cureuma*) and striped (*M. cephalus*) mullet, spotted seatrout (*Cynoscion nebulous*), and gray snapper (*Lutjanus griseus*), captured in the marine waters of Everglades National Park were performed. Survival was found to be related to the method of fish capture. Striped mullet mortality rates were 16% for fish caught by commercial purse seines; 33% caught by gill nets; and 0% caught by trammel nets. White mullet, which were all caught with gill nets, had mortality rates of 77.4% while gray snapper was 0%. Mortality of spotted seatrout was 45% for fish caught in nets and 5% for fish caught by angling.-Adapted from authors' abstract.

216. Ludwig, G. M., J. E. Skjeveland and N. A. Funicelli. 1990. Survival of Florida Bay fish tagged with internally anchored spaghetti tags. Fla. Sci. 53:38-42.

Studies were conducted from January 1984 to September 1985 to determine movement and estimate population sizes of certain commercial and sport fishes in the coastal marine waters of ENP (Florida Bay-Ten Thousand Islands) and experiments to determine mortality caused by tagging and the amount of tag shedding were conducted as part of that research. The percent survival of Florida Bay white mullet, striped mullet, spotted seatrout, and gray snapper marked with internally anchored spaghetti tags was 22, 67, 75, and 100, respectively. Unmarked fish of the same species had survival percentages of 27, 77, 75, and 100, respectively. Transporting the fish up to 16 km from the point of capture did not significantly decrease survival in either tagged or untagged fish.

Study Period:January 1984 to September 1985; Study Type:Qualitative, quantitative; Habitat:Open bay waters; Dominant Taxon/Taxa Studied:White mullet *Mugil curema*, Striped mullet *M. cephalus*, spotted seatrout *Cynoscion nebulous*, gray snapper *Lutjanus griesus*.

217. Lutz, P. L. and A. C. Dunbar-Cooper. 1982. The nest environment of the American crocodile, *Crocodylus acutus*. T-671. Homestead, Fl: South Florida Research Center, Everglades National Park. 38 pp.

In Florida Bay (ENP), crocodile nests from two different substrates, sand-shell and marl were studied during the nesting season of 1979-80. Changes in temperature,

soil water, and gaseous composition were monitored in selected nests throughout incubation. Seasonal and diurnal fluctuations in nest temperatures were given; no differences were found among nest types. Nest soil water values and loss of water in eggs over the incubation period were discussed. A decline in oxygen and a rise of carbon dioxide was found in all nests during incubation, and, along with soil composition, there were wide variations found among both nest types. The authors suggested that the metabolic rate of the nest clutch of *C. acutus* was regulated by oxygen and carbon dioxide levels in the nest. Important similarities in crocodilian and bird egg development were discussed. It was concluded that no direct evidence was found to establish the internal nest environment as limiting to the *C. acutus* population in Florida Bay.

Study Period:1979-80; Study Type:Qualitative, quantitative; Habitat:Mangrove swamp/marl, sand-shell; Number of Stations:9 (7 regular, 2 control); Temporal Frequency:Diurnal/weekly/seasonal; Biological Component:Marine reptile (crocodile); Abiotic Parameters Measured:Soil water temperature, salinity, DO, particle size; Dominant Taxon/Taxa Studied:*Crocodylus acutus*.

218. Lutz, P. L. and A. C. Dunbar-Cooper. 1984. Nest environment of the American crocodile, *Crocodylus acutus*. Copeia :153-161.

Narrative same as in reference no. 217.

219. Lynts, G. W. 1962. Distribution of Recent Foraminifera in upper Florida Bay and associated sounds. Cushman Found. Foram. Res. Contr. 13(4):127-144.

The distribution of the total population and standing crop from upper Florida Bay (ENP), and associated sounds was investigated for distributional factors. A total of 68 samples were collected and investigated (53 within ENP) for foraminiferal content. The total population was used to divide the area into four provinces including upper Florida Bay and Blackwater Sound in ENP. It was found that sediment size may be a factor in controlling the distribution of certain species, foraminifera were not wave or current sorted, and most of the families identified in the total population have living representatives in the area.

Study Period:1958, 1960; Study Type:Qualitative, quantitative; Gear Type:Dredge, grab; Number of Stations:68 (53 in NE Florida Bay, ENP); Temporal Frequency: Once; Habitat:Bottom sediment; Biological Component:Foraminifera; Abiotic Parameters Measured:Water depth, sediment characteristics.

220. Lynts, G. W. 1971. Distribution and model studies on foraminifera living in Buttonwood Sound, Florida Bay. Miami Geol. Soc. Mem. 1:73-115.

Environmental factors influencing foraminiferal species distribution in Buttonwood Sound, Florida Bay (ENP), were studied using 74 samples from 19 stations. Depth, temperature, salinity, pH, and Eh were measured at sediment water interface. The foraminiferal standing crop and granulometry of each sample were determined. The distribution of foraminifera was determined to be controlled by a complex interaction of physicochemical and biologic factors, which was only partially revealed by the measured parameters.

Study Period:Aug.1962-Feb. 1963; Study Type:Quantitative; Habitat:Mud,sand; Gear Type:Corer, grab samples; Number of Stations:19; Temporal Frequency:4 times (Aug. 14,17,20, 1962; Feb. 1967); Abiotic Parameters Measured:Salinity, temperature, depth, pH, Eh, sediment grain size.

221. Lynts, G. W. 1965. Observations on some Florida Bay Foraminifera. Cush. Found. Foram. Res. Contr. 16:67-69.

Three species of foraminifera (*Valvulina oviedoiana*, *Triloculina bassensis*, and *Bolivinita rhombodalis*) from Florida Bay (ENP) and Card Sound are described and discussed.

Study Type:Qualitative; Biological Component:Foraminifera.

222. Lynts, G. W. 1966. Relationship of sediment-size distribution to ecologic factors in Buttonwood Sound, Florida Bay. J. Sediment. Petrol. 36:66-74.

Some ecological factors in Buttonwood Sound in the eastern Florida Bay area of ENP were studied in relation to the sediment-size distribution. Statistical analysis show that ecological factors studied (salinity, depth, temp., pH, Eh) were not linearly related to sediment-size nor amongst themselves. Sediment distribution was found to be largely related to turtle grass occurrence. Temperature and salinity were related to climate, while pH and Eh were related to organic activity. Carbonate sediments of Buttonwood Sound are almost wholly organically derived.

Study Period:August 1962-February 1963; Study Type:Quantitative; Gear Type:Cores; Number of Stations:19; Temporal Frequency:4 collections - Aug. 14,17,20 & Feb. 9; Biological Component:Seagrasses, sediment characteristics; Abiotic Parameters Measured:Salinity, temp., pH, Eh, depth.

223. Lynts, G. W. 1966. Variation of foraminiferal standing crop over short lateral distances in Buttonwood Sound, Florida Bay. Limnol. and Oceanogr. 11(4):562-566.

An analysis of standing crop of the foraminiferans collected from 19 stations in Buttonwood Sound, eastern Florida Bay (ENP), indicated that there was no significant faunal variations at 10 of the 19 stations indicating foraminiferal microhabitats of at least 30 $m^2$. Percentage data analysis indicated that foraminiferal standing crop varied among samples and species composition varied considerably between samples at each station. It was found that dominant species were quite constant between samples at each station and variation was caused by fluctuation in rarer species.

Study Period:August 1962; Study Type:Quantitative; Habitat:Basin (mud, sand); Gear Type:Cores, grab samples; Number of Stations:19; Temporal Frequency:4 collections; Biological Component:Foraminifera; Abiotic Parameters Measured:Salinity, temperature, depth, pH, Eh.

224. Mahadevan, S., J. Sprinkel, D. Heatwole and D. H. Wooding. 1984. A review and annotated bibliography of benthic studies in the coastal and estuarine areas of Florida. Fla. Sea Grant Coll., Rept. No. 66. 576 pp.

This report provides the reader with a reference document on available information (published and unpublished) on the benthic environment and its flora and fauna of Florida's estuarine and coastal areas. A compilation of over 1500 benthic studies (70% were unpublished) was presented on the benthos (and its environment) through the year 1982; earliest studies annotated were published in 1918. Behavioral, morphological, or taxonomic studies of single species were excluded from the bibliography. Worldwide methodological references and taxonomic citations pertinent to the flora and fauna of the coastal and estuarine areas of Florida were also provided.

Study Type:Bibliography/review (benthos); Habitat:Estuarine/coastal marine; Biological Component:Flora & fauna.

225. Manker, J. P. 1975. Distribution and concentration of mercury, lead, cobalt, zinc, and chromium in suspended particulates and bottom sediments - upper Florida Keys, Florida Bay, and Biscayne Bay. Ph.D. Dissertation, Rice Univ., Houston, Tex. 125 pp.

In this investigation sediment samples from 39 stations in the upper Florida Keys, Florida Bay (ENP), and Biscayne Bay were collected and analyzed for mercury, lead, cobalt, zinc, and chromium. The highest concentrations of toxic metals were found in the 4-u and suspended particulate fractions and were correlated with areas of high population/human activity and with the Turkey Point nuclear/fossil fuel plant. Concentrations of lead and mercury in bottom sediments in certain areas (Tavernier Key and restricted basins in Florida Bay) are reaching environmentally unacceptable levels. A reduction in seagrass and green algae populations was found in areas of maximum toxic metal concentrations.

Study Period:June-August 1973, May-June 1974; Study Type:Quantitative; Habitat:Water column, lagoonal basins;mud, sand, coral reef; Number of Stations:39 (13 in/or adjacent to Florida Bay); Temporal Frequency:Monthly during 2 summers; Abiotic Parameters Measured:Salinity, temp., DO, turbidity, current speed & direction, wind speed & direction.

226. Manker, J. P. and G. M. Griffin. 1969. Distribution of silicate minerals in Florida Bay. IN Geology of the American Mediterranean. Gulf Coast Assoc. Geol. Soc. Trans. 19:505.

No abstract available.

227. Manker, J. P. and G. M. Griffin. 1971. Source and mixing of insoluble clay minerals in a shallow water carbonate environment-Florida Bay. J. Sediment. Petrol. 41(1):302-306.

Sediment samples from 21 stations in the Florida Bay portion of ENP were analyzed for clay mineralogy. It was found through X-ray diffraction techniques

that chlorite and smectite dominate the clay-size insoluble residue of Recent carbonate sediments; Illite and kaolinite also occur in small quantities. Chlorite is derived from the Atlantic Coast and eastern Everglades provinces and is introduced by streams and tidal channels through the northern Florida Keys. Smectite is derived from the Gulf of Mexico province to the west. In the northern part of the Bay, water flow is greatly impeded by a complex bank and basin system, and the clay mineral suites remain relatively segregated near their respective sources. However, in the southern part of the bay, banks are less frequent, water flow is less impeded, and the clay mineral suites mix gradually across the area.

Habitat:Mud; Type of Study:Qualitative; Gear Type:Clam-shell grab; Number of Stations:21; Abiotic Parameters Measured:Sediment grain size & composition, clay minerals.

228. Manker, J. P., A. R. Hill and C. S. Johnston. 1982. Toxic metal concentrations and distribution in Tavernier and Tarpon Basin, Florida Bay. Ga. J. Sci. 40(1-2):21.

No abstract available.

229. Manning, R. B. 1961. A redescription of the palaemonid shrimp, *Leander paulensis* Ortmann, based on material from Florida. Bull. Mar Sci. Gulf and Carib. 11(4):525-536.

A redescription and measurements of the palaemonid shrimp, *Leander paulensis* is presented based on collections of specimens in northern Florida Bay (ENP). Characteristics of *L. paulensis* are closely compared with morphological criteria of a species that it had been synonymized, *L. tenuicornis*. The author concludes that *L. paulensis* is a tropical inshore species and now separate from the littoral stocks of *L. tenuicornis*.

Study Period:1958-1959; Study Type:Qualitative; Habitat:Basins/banks seagrass-macroalgae beds; Biological Component:Decapod crustacea; Abiotic Parameters Measured:Salinity; Dominant Taxon/Taxa Studied:*Leander paulensis*.

230. Manning, R. B. 1960. Some growth changes in the Stone Crab, *Menippe Mercenaria* (Say). Quart. J. Fla. Acad. Sci. 23(4):273-277.

Morphological differences between juvenile and adults of *Menippe mercenaria* were studied in specimens collected from northern Florida Bay (ENP). In juveniles the orbits are far apart, while in the adult they are close together. Juveniles differ from adults in not showing subdivisions of the submedian frontal lobes and the striulating organ on the palm. The juveniles lateral teeth are smoother and rounder, the coloration is dark, and they are most often found in channels from October to April indicating a protracted spawning period. Juveniles do not form permanent burrows.

Study Period:1957-1959; Study Type:Qualitative; Habitat:Channels; Biological Component:Xanthid crab; Number of Stations:Variable; Gear Type:Trawl; Dominant Taxon/Taxa Studied:*Menippe mercenaria*.

231. Marshall, A. R. 1954. A survey of the snook fishery of Florida, with studies of the biology of the principal species, *Centropomus undecimalis* (Bloch). M.S. Thesis, Univ. of Miami, Coral Gables, Fla. 116 pp.

Aspects of abundance, distribution, spawning, age, size, habitat, and food habits of the thin (common) snook were investigated in the 10,000 Islands, from Naples to the Everglades City portion of ENP. Supplemental collections were obtained from the west and east coasts of Florida and from museums. A brief historical resume of the sport and commercial fishery was presented. A steady commercial fishery has existed in the southern portion of the state since the 1930's; commercial production reached a peak in 1948, at 800,000 lbs. Commercial gears which produce snook include mullet gill and trammel nets, stop and snook gill nets and H & L. The dominant species of the catch is the thin (common) snook, *Centropomus undecimalis*, and is much the largest of the three Florida species. This species is very sensitive to temperature change, a low of 60°C is the minimal safe level; snook tolerate salinities from 0 to 36 ppt, with its distribution centered in intermediate brackish waters. Spawning occurs predominantly from June to November; most fish are all adult at 500 mm FL. *C. undecimalis* is carnivorous feeding primarily on fishes and crustaceans. No young-of-the-year fish were taken in this study. It was suggested by the author that declines in the snook populations are attributed primarily to alterations in environmental conditions.

Study Period:1954-1955; Study Type:Qualitative; Gear Type:Gill, trammel and seine nets, H & L, rotenone; Habitat:Estuarine and coastal marine mangrove swamp; Biological Component:Sport & commercial fish; Abiotic Parameters Measured:Salinity, temp.; Dominant Taxon/Taxa Studied:*Centropomus undecimalis*.

232. Marshall, A. R. 1958. A survey of the snook fishery of Florida, with studies of the biology of the principal species, *Centropomus undecimalis* (Bloch). Fla. St. Bd. Conserv., Tech. Ser., No. 22, 37 pp.

Narrative same as in reference no. 231.

233. Mathis, J. M. 1973. Red Mangrove decomposition: a pathway for heavy metal enrichment in Everglades estuaries. M.S. Thesis, Fla. State Univ., Tallahassee. 60 pp.

Red mangrove decomposition was studied as a natural pathway for heavy metal enrichment in estuaries, primarily within and/or adjacent to the extreme western boundary of ENP. Red mangrove leaves were analyzed in several decomposition stages for heavy metal concentration. Results of analysis revealed a 3 to 200-fold enrichment of Fe, Mn, Cu, and Cd in the detritus compared to living leaves. This enrichment process is thought to be primarily due to absorption, complexion and concentration of dissolved metals by the mangrove detritus and its associated microbiota. Comparisons between the Barron River estuary, which receives its drainage from agriculturally developed areas, and the Shark and Broad River estuaries, which receive drainage from undeveloped areas, revealed a significantly higher concentration of Cu and Cd in Barron River leaves and a higher concentrations of Mn, Fe, and Cu in Barron River detritus than in the leaves and detritus of the uncontaminated estuaries. This increase in heavy metal

concentrations is probably due to the metal-containing pesticides and fertilizers applied to farmlands drained by the Barron River estuary.

Study Period:Oct 1971, June, August, 1972; Study Type:Qualitative, quantitative; Gear Types:Nets, hand; Number of Stations:30; Temporal Frequency:Three wet season sample periods; Habitat:Water column, mangroves; Biological Component:Mangrove leaves, litter, detritus, phytoplankton; Abiotic Parameters Measured:Heavy metals (Mn, Fe, Cu, Cd), salinity, temperature, Total Sus. Load, DOC; Dominant Taxon/Taxa Studied:*Rhizophora mangle.*

234. Mattraw, H. C. 1973. Cation exchange capacity and exchangeable meatals in a south Florida watershed. Ph.D. Dissertation, Fla. State Univ., Tallahassee.

Studies were conducted on exchangeable metals as represented in their presence in fertilizers and pesticides from soils collected from canals and rivers located in and near the estuaries of the Big Cypress estuary (ENP). Comparisons between Chokoloskee Bay, which receives its drainage from partially developed areas, and Lostman's Five Bay, which is isolated from man's activities are difficult because of the low levels of exchangeable metals present and the few samples analyzed. A nonparametric test of variance indicates that Chokoloskee sediments are significantly enriched in exchangeable Co, Cu, ZN, and Pb over samples from Lostman's Five Bay.

Study Period:October 1971, February 1972; Study Type:Quantitative; Habitat:River, canal, bay sediments; Number of Stations:Oct (12 in ENP), Feb (4 in ENP); Temporal Frequency:Twice; Abiotic Parameters Measured:Sediment ph/Eh, exchangeable metals (Cu, Cd, Pb, Mn, Fe, Zn, Co).

235. May, J. A. and R. D. Perkins. 1969. Endolithic infestation of carbonate substrates below the sediment-water interface. J. Sediment. Petrol. 49(2):357-378.

Carbonate substrates were planted both at and below the sediment-water interface in North Carolina, the Florida Bay portion of ENP, and in Belize. It was found through SEM analysis, TEM analysis, and light microscopy that a diverse assemblage of endolithic forms was found at the sediment-water interface while a less diverse and different assemblage of endolithic forms was detected below the sediment-water interface. This is the first known report of such activity within buried marine sediments. The most abundant subsurface endoliths were two coccid forms; in contrast, blue-green algal forms dominated sea floor samples. It was concluded that endolithic activity within buried marine sediments broadens the environmental conditions under which microborings may form, suggesting that endoliths may significantly affect the surrounding microenvironment within sediments which may result in porosity development during early sediment burial.

Study Period:6-14 months(Florida Bay); Study Type:Qualitative; Gear Type:PVC pipe, plexiglass plates; Number of Stations:4(Cross Key Bank, Cluett Key in Florida Bay); Habitat:Mud; Biological Component:Diatoms, algae; Dominant Taxon/Taxa Studied:Coccid Forms A & B, *Plectonema terebrans, Mastigocoleus testarum.*

236. Mazzotti, F. J. 1983. The ecology of *Crocodylus acutus* in Florida. Ph.D. Dissertation. The Pennsylvania State Univ., University Park, Pa.

The ecology of the American crocodile was investigated in southern Florida, mostly within the northeastern portion of Florida Bay, ENP, during 1976-1981. *Crocodylus* formerly occupied a broader range in southeastern Florida. Current core distribution of *C. acutus* is the extreme southern Florida mainland and northern Key Largo. They occupy bays, ponds, rivers, canals, and creeks in mangrove swamps. Recruitment into the breeding population is occurring. Crocodiles nest on beaches, creek and canal banks, composed of marl, peat, or sand. Hatchling failure is due to desiccation and flooding. Approximately 200 hatchlings are produced in ENP annually. Based on laboratory experiments, it was suggested that the intake of brackish water combined with rapid growth to a more salt tolerant size allows for the specialization of *Crocodylus* for life in saline water. Additional data is presented on their ecology in the Turkey Point power plant cooling canal system.

Study Period:1976-1981; Study Type:Quantitative, qualitative; Gear Type:Field survey-Boat/canoe/aircraft, capture technique-hand/tongs/noose, radio telemetry; Habitat:Marsh, mangrove swamp (ponds, creeks, coves, flats), Bay shoreline; Biological Component:Marine reptile; Abiotic Parameters Measured:Salinity, rainfall, water levels and depth, wave height, air & water temp.; Dominant Taxon/Taxa Studied:*C. acutus*.

237. Mazzotti, F. J. 1989. Factors affecting nesting success of the American crocodile, *Crocodylus acutus*, in Florida Bay. Bull. Mar. Sci. 44:220-228.

Approximately two-thirds of the nests of the American crocodile in Florida occur in ENP along sandy shorelines and marl creek banks in northeastern Florida Bay. Of 104 crocodile nests examined between 1970 and 1982, 74% produced at least one hatchling. Most eggs (58%) in each successful nests hatched, while 43% of all eggs laid produced hatchlings. Egg mortality was caused by predation (13% of 104 nests), and embryonic mortality (13% of 104 nests), resulting from flooding and desiccation. Nest temperatures apparently did not kill developing embryos, but deformed hatchlings were observed from hot (>36.5°C) nests. Disturbance to nesting females may result in abandonment of nests during incubation and relocation of nesting effort in subsequent years. The timing of nesting seems to be scheduled, with the developmental period bracketed by desiccating and flooding conditions, and periods of low and high temperatures. The success of this strategy is shown by the relatively low rate of nest failure in most years.

Study Period:1970-1982; Study Type:Qualitative; Habitat:Creek, shoreline, island; Biological Component:Marine reptile; Gear Type:Field observations by aircraft, boat, on foot; Number of Stations:Variable; Abiotic Parameters Measured:Nest temperature, water levels, rainfall; Dominant Taxon/Taxa Studied:*Crocodylus acutus*.

238. Mazzotti, F. J. 1988. Science, politics, and management of crocodilians in the Everglades. IN G.W. Dalrymple, W. F. Loftus & F.S. Bernardino, Jr., Abstracts of the Proceedings of the first Everglades N.P. Symposium (Wildlife in the Everglades and Latin America wetlands), Fla. Inter. Univ., Miami, Fla. 1985.

This paper provides a review of the important influences which are determinants of management decisions in wildlife management: namely, scientific or biological knowledge; political influences including the different philosophies of the managing agencies/owners of crocodile critical habitat (NPS-ENP, FWS-North Key Largo Wildlife Refuge, and FPL-Turkey Point power plant site) and, although the final management practices may differ, they must all be based on good scientific data. A summary is presented on recent crocodilian research conducted by the author in the Florida Bay area of ENP. Results indicate that the number of crocodile nests are stable, if not increasing, and that the long-term outlook for the crocodile in Florida was good. However, increased water releases through the C-111 canal system may be increasing the flooding of creek nests which produce the surviving hatchlings. A brief summary of alligator research in ENP is also given.

Study Period:1977 to present; Study Type:Biological review; Biological Component:Marine reptiles; Dominant Taxon/Taxa Studied:*Crocodylus acutus*.

239. Mazzotti, F. J., J. A. Kushlan and A. C. Dunbar-Cooper. 1988. Desiccation and cryptic nest flooding as probable causes of egg mortality in the American crocodile, *Crocodylus acutus*, in Everglades National Park, Florida. Fla. Sci. 51(2):65-71.

Flooding and desiccation probably caused mortality of eggs of the American Crocodile in the Florida Bay area of ENP. Flooding was subterranean with no sign evident above ground. Apparent desiccation occurred in a year (1981) of abnormally low rainfall. The timing of the nesting seems to be rigidly scheduled, with the developmental period bracketed by possibly desiccating and flooding conditions. The success of this strategy is shown by the relatively low rate embryonic mortality in most years.

Study Period:1980-1981; Study Type:Qualitative; Habitat:Shoreline, creeks; Gear Type:Field observations by boat, helicopter, on foot; Biological Component:Marine reptile; Number of Stations:Nest sites-1980 (8), 1981 (9); Abiotic Parameters Measured:Water levels, rainfall, salinity; Dominant Taxon/Taxa Studied:*Crocodylus acutus*.

240. McCallum, J. S. and K. W. Stockman. 1961. Salinity of Florida Bay. Amer. Assoc. Petroleum Geol. Symp., Denver, CO. p. 78. (Abs.).

These authors made extensive bimonthly collections at 75 stations in eastern Florida Bay (ENP) during an unusual dry year from December 1956 to December 1957, and found salinities as high as 58 ppt. When normal rains returned in 1958, salinities were again on the brackish side. Comparing their data to rainfall records from previous years, the authors concluded that Florida Bay undergoes a cyclic alternation of brackish to hypersaline to brackish water in response to variations in rainfall. It was determined that in order to have runoff into Florida Bay there must be enough rainfall to raise the mainland water table to above that of Bay level.-Adapted from authors' abstract.

241. McCallum, J. S. and K. W. Stockman. 1972. Water Circulation. IN R.N. Ginsburg (ed.), South Florida Carbonate Sediments. Sedimenta II, Comparative Sedimentary Lab.:Univ. of Miami, Fisher Island Station, Miami Beach FLA. 72 p., Miami, Fl. 11-14.

This paper provides a summary review of the restricted exchange of water in Florida Bay (ENP) based on topography and the effect of variations in rainfall on Florida Bay salinity and water levels. A north-south gradient in salinity was found in Florida Bay as a result of runoff produced by mainland and Bay water levels, and by the excess of rainfall over evaporation. The authors suggest that the general salinity level of northern Florida Bay has fluctuated from brackish to hypersaline in a period of 5 to 7 years. Hydrographic zones of Florida Bay are presented.

Study Type:Qualitative (review).

242. McNulty, J. K., W. N.,Jr. Lindall and J. E. Sykes. 1972. Cooperative Gulf of Mexico estuarine inventory and study, Florida: Phase I, Area Description. NOAA Technical Rept. NMFS. Circ-368. 126 pp.

This report presents the results of a cooperative inventory of estuaries in the Gulf of Mexico. Phase 1, the area description for the Florida inventory, combines original observations with a review of earlier data on submerged vegetation, hydrology, geology, fisheries, human population and economic development from four major coastal/estuarine areas including the Florida Bay to Cape Romano area (mostly within ENP). Areas adversely affected by pollution, excluding Florida Bay, were discussed.

Study Type:Environmental review.

243. McPherson, B. F. 1970. Hydrobiological characteristics of Shark River estuary, Everglades National Park, Florida., Dept. of Inter., Geol. Surv. Miami, FL, Open-File Report 71002, 113 pp. (mimeo).

This report presents the results of hydrobiological studies in the 20-mile long Shark River estuary, ENP. Water quality in the estuary was strongly influenced by seasonal patterns of rainfall, water level and temperature. During the rainy season (summer-early fall) salinity ranged from freshwater to brackish water while concentrations of dissolved oxygen were low, 2.5 mg/l presumably because microbial activity and respiration were accelerated by high temperatures (30-33°C). During the dry season (late fall-spring), salinity ranged from 18 g/l in the headwaters to 36 g/l at the Gulf. Concentrations of dissolved oxygen increased from 2-3 mg/l in the summer of 1967 to 4-7 mg/l in the winter of 1968, and temperature decreased from a mean of 30°C in summer to 20°C in winter. Decaying organic matter and decreased photosynthesis due to low water levels and high salinities resulted in low DO and fish kills. Trace metals, heavy metals, and insecticides occurred in the water in concentrations below National Standards. Patterns of distribution of planktonic and small nektonic animals were related to

salinity. Presence of large numbers of juvenile and young animals indicated the importance of the estuary as nursery grounds. Small fish and prawns, which were concentrated in the headwaters as the water levels dropped, served as rich food source for predatory marine fish and birds.

Study Period:1967-68; Study Type:Qualitative; Habitat:River, bays; Biological Component:fauna; Abiotic Parameters Measured:Salinity, temperature, DO, metals, insecticides.

244. McPherson, B. F., G. Y. Hendrix, H. Klein and H. M. Tyus. 1976. The environment of south Florida, a summary report. Geol. Surv. Prof. Pap. 1011. 81 pp.

This report summarizes the scientific information database collected on the south Florida environment as a result of a variety of governmental (NPS, USGS, EPA, BSF&W, NMFS, BOR, etc.) and private (Univ. of Fla.) studies undertaken during the early 1970's to determine the effects of a proposed international jetport on the ecosystem of ENP. This report concludes phase one of the phase two project, South Florida Environmental Study, which described and identified the natural ecosystems of south Florida as they functioned before man began to have major impacts on these systems. The study also encompassed the agricultural and urban developments of south Florida and their impacts on the ecosystems. Topics covered as they pertain to the coastal and estuarine environments of ENP include: mangroves and salt marshes, shallow estuaries and bays, marine fisheries, water quality and pesticide effects. The authors conclude that by developing a thorough knowledge of the south Florida environmental system and the flow of energy through that system, planning and development can occur and permit full use and enjoyment of south Florida's natural resources without destroying those resources.

Study Period:1970-74; Study Type:Environmental/ecosystem summary/review; Study Type:Quantitative & qualitative.

245. Meeder, J. F. and L. B. Meeder. 1989. Hurricanes in Florida Bay: A dominant physical process. Bull. Mar. Sci. (Abstract) 44:518.

Hurricanes produce major ecological perturbations important to long-term maintenance of the Florida Bay ecosystem. Just as the importance of fires has been recognized in the management of terrestrial ecosystems, the role of hurricanes on coastal and shallow bay communities must also be recognized. Intense periods of rapid runoff appear to be very significant in maintaining the Florida Bay ecosystem. Physical processes associated with hurricanes are rainfall, storm tides, extreme winds and waves, and outwash. From the analysis of storm data collected since 1916, two generalizations can be made: 1) storms that affect the Bay bottom and coastline occur at fairly predictable intervals of one every 3 to 5 years; and 2) storms that produce extreme freshwater runoff occur once every 6 to 7 years.-Adapted from authors' abstract.

246. Mengel, L. J., M. R. Dewey, H. E. Bryant, N. A. Funicelli, G. M. Ludwig and D. A. Meineke. 1989. Relative abundance and standing stock estimates for finfish in Florida Bay using trammel nets. Bull. Mar. Sci. (Abstract). 44:518.

This investigation estimated relative abundance and standing stocks of the major sport and commercial fish species from quantitative trammel net samples, collected monthly throughout the estuarine and coastal marine waters of ENP park on a random basis. From June 1984 to June 1985 , 689 random sets yielded 86 species, of these, 72 species were taken in 477 sets in Florida Bay, 66 species were taken in 135 sets on the west coast, while 77 sets in Whitewater Bay yielded 27 species. The west coast had higher fish density than Florida Bay. In decreasing order of abundance, the most abundant species in Florida Bay were pinfish, sea catfish, gray snapper, spotted seatrout, and crevalle jack, while sea catfish, gafftopsail catfish, striped mullet, spotted seatrout, and pinfish were the most prevalent species in west coast samples. Monthly relative abundance was also estimated by habitat type and physical parameters.-Adapted from authors' abstract.

247. Merriam, D. F. 1989. Overview of the geology of Florida Bay, review of recent developments. Bull Mar. Sci. (Abstract). 44:519.

Florida Bay (ENP), a shallow-water, triangular-shaped area of about 1,000 sq. mi. is wedged in between and protected by the Florida mainland and the Florida Keys. It is open to the southwest into the Gulf of Mexico, but the open-water effects on the Bay are dampened by the anastomosing mudbanks, which cordon the Bay into a series of internal basins. Major changes in the Bay usually occur during severe storms. Because of its geographic position, climate, and geological factors, carbonate sediments are generated in the bay. Its accessibility and conditions make it a popular modern analog for understanding ancient sediments in the rock record deposited under similar conditions. The study of the Bay can be divided into three segments 1) early exploration and description (1850 to 1953); 2) general stratigraphy and sedimentology (1953 to 1977); and 3) detailed, in depth studies (1977 to present).-Adapted from author's abstract.

248. Merriam, D. F. 1988. Some recent developments in the study of Florida Bay geology. The Compass 65(30):157-174.

Recent work in Florida Bay, mostly within the boundaries of ENP, has kindled a resurgence of interest in this dynamic lime-mud factory. History of work in the area can be subdivided into three periods: (1) early exploration and description (1850-1953), (2) general stratigraphy and sedimentology (1953-1977), and detailed studies (1977-present) on the generation, distribution, accumulation,alteration, and preservation of the lime mud on the Pleistocene surface during the past 5,000 years. Sea-level change has been refined- physical, chemical, and biological features of the Bay have received considerable attention and much new data have been collected with drilling of core holes in the Bay. It is now possible to simulate processes operational in the Bay and predict changes. Simulation show that the Bay is infilling from the west and north, and that sea-level change is the dominant factor affecting the end result. The direction of future research in Florida Bay is discussed.

Study Type:Review.

249. Merriam, D. F., J. M. Fuhr, R. V. Jenkins and P. J. Zimmerman. 1989. Pleistocene bedrock geology of Florida Bay, the Keys, and the Everglades. Bull. Mar. Sci. (Abstract). 44:519.

The Late Pleistocene Miami Limestone of southern Florida comprises three facies: bryozoan, coral, and oolite. The coral facies of Miami is termed the Key Largo Limestone and the oolitic facies the Miami Oolite. The three facies interfinger locally and are approximately 130,000 years old. The Florida Keys are an archipelago of coral limestone islands and extend from Miami southwest to Bahia Honda Key, and continue under water as far west as the Dry Tortugas. On the mainland, the oolitic facies extends as a thin sheet several miles into the Everglades. The bryozoan facies, which covers approximately 3,000 sq. mi from the southern coast of Florida into the Everglades, underlies most of Florida Bay (ENP), but in a more complicated manner than previously suspected. Patch reef(s) and freshwater limestone have been observed in the Bay.-Adapted from authors' abstract.

250. Merriam, D. F. and T. M. Quinn. 1989. Recent sediments of Bald Eagle Key and implications for Florida Bay island stratigraphy. Bull. Mar. Sci. (Abstract). 44:520.

Bald Eagle Key, a low-lying, saucer-shaped, mangrove-fringed island in the Florida Bay portion of ENP, is located between easternmost Bob Allen and Captain Key and is one of approximately 170 islands (=keys) in the Bay. The islands are composed of soft, carbonate mud that has accumulated over the Miami Limestone (Pleistocens) "bedrock" during sea level rise throughout the past 5,000 years. The "normal" stratigraphic succession (A) of sediments forming the islands consists of (a) freshwater marl, (b) mangrove peat, (c) shelly marine carbonate mud usually with live mangrove roots, and (e) a cream-covered flaky supratidal carbonate mud (locally laminated). On other islands, another sequence (B) of events consists of only (a), (b), and (e). Events (a) through (c) have been interpreted as transgressive, and events (d) to (e) regressive. Interpretation of sequence (A) is that of islands formed by mangrove colonization of marine mudbanks; whereas for (B) islands nucleated from a supratidal precursor. Both mechanisms are equally viable for island initiation.-Adapted from authors' abstract.

251. Merriam, D. F., S. Sengupta and C. E. Sorensen. 1989. Definition and implications of the sub-environments of Florida Bay. Bull. Mar. Sci. (Abstract). 44:520.

The sub-environments of Florida Bay have been defined in several different ways. Salinity levels have been used to subdivide the Bay into hydrographic zones; molluscan assemblages have been used to recognize sub-environments, and the net sediment budget used to arrive at sediment accumulation zones. Water properties such as salinity, pH, dissolved oxygen, dissolved carbon dioxide, turbidity, calcium, and magnesium along with sedimentological, geochemical, and biological properties of the sediments were analyzed statistically to outline four sub-environments. The boundaries fluctuate reflecting the dynamic conditions in the Bay. The water properties show a distinct reorientation from winter to summer reflecting the change from the dry to wet season. These changes are attributed to wind direction, nutrient supply, rainfall, water circulation, and basin configuration.-Adapted from authors' abstract.

252. Merriam, D. F., S. Sengupta and P. J. Zimmerman. 1985. Regional water-chemical properties affecting the water/sediment interface in Florida Bay. The Compass 62(2):107-115.

Florida Bay is a prolific carbonate factory and is of interest to researchers as a modern analog to ancient conditions. Water samples from 21 stations in the Bay portion of ENP were collected and analyzed for salinity, pH, dissolved $CO_2$ and $O_2$ and turbidity using a HACH water chemistry kit on site. Variations in water and sediment characteristics are important in determining the origin, distribution, and accumulation of the Recent sediments. It was found through trend-surface analysis that salinity is normal in the center of the Bay, decreasing to brackish conditions along the margins, dissolved $CO_2$ is higher in the center of the Bay, while $O_2$, pH, and turbidity decrease towards the central part of the Bay. In general, the salinity and $CO_2$ of the water decrease as $O_2$, pH, and turbidity increase. These conditions are the result of a complex interplay of basin configuration, circulation, dilution and pollution, animal activity and vegetation, light, temperature, sediment availability, and many other factors.

Study Period:January 1984; Study Type:Qualitative, quantitative; Number of Stations:21; Abiotic Parameters Measured:Salinity, temperature, DO, $CO_2$, pH, Turbidity, water depth, sediment type.

253. Merriam, D. F., C. E. Sorensen and R. V. Jenkins. 1987. Modern carbonate sediments in Shell Key Basin, Florida Bay. Symposium on the Geology of South Florida: Miami Geol. Soc. Mem. 3:73-90.

Shell Key Basin, bordered on the east by Upper Matecumbe Key and mangrove islands on the west within the boundaries of ENP in Florida Bay was studied through a period of two years. Water and sediment samples were collected from 13 stations in the Basin; additional sites were sampled in north central Florida Bay for comparative purposes. It was found through sonic depth profiles and sediment cores that the same microkarst features are under the basin as are exposed farther north on the mainland. Analysis of results indicate that sediments accumulating in the basin has a bimodal size distribution from Penicillus secretions and abraded bioclastic debris. Storm-driven currents are responsible for sediment distribution and composition. In general, the salinity and $CO_2$ of the water decrease as pH and turbidity increase; salinity changes are the result of dilution and circulation; $CO_2$ changes result from vegetation,light, and temperature; pH is affected by $CO_2$ production and circulation; and turbidity is due to depth, agitation, and availability of loose material. It was suggested that there is a topographical low area parallel to the present keys and extending north seemingly an extension with present-day drainage.

Study Period:Jan 1980-Apr 1983; Habitat:Water column, mud, bedrock; Study Type:Qualitative; Gear Type:Cores, grab samples; Number of stations:14; Abiotic Parameters Measured:Salinity, temp, depth, DO, $CO_2$, pH, sediment characteristics, turbidity.

254. Miller, E. M. 1940. Mortality of fishes due to cold on the southeast Florida coast, 1940. Ecology 21(3):420-421.

This paper reports on the mortality of fishes due to a depression in air temperatures during January, 1940 in southeast Florida. Water temperatures of 55°C were reported in the extreme NE Florida Bay portion of ENP (Jewfish Creek area). A list of fishes which were observed to be stunned or killed was presented.

Study Period:January 27-29 1940; Study Type:Qualitative; Habitat:Estuarine, nearshore; Biological Component:Fish; Dominant Taxon/Taxa Studied:Bonefish, moonfish, grey snapper, grunts, porgie, mullet, jacks.

255. Mitchell-Tapping, H. J. 1987. Application of tidal mudflat model to Sunniland Formation (Lower Cretaceous) of south Florida. Am. Assoc. Petrol. Geol. Bull 70(1120). (Abs.).

The present day Florida Bay analog is used to determine the various environmental subzones and controls on the deposition of the Sunniland Formation, an oil-producing field formerly interpreted as reef deposits, but now, based on petrologic evidence from cores and wells, considered to have been deposited in a mudflat environment. This information has been used to extend the model throughout the south Florida basin and has given new insights into the tectonics of this basin.-Adapted from author's abstract.

256. Mitchell-Tapping, H. J. 1980. Depositional history of the oolite of the Miami Limestone Formation, Florida USA. Fla. Sci. 43(2):116-125.

The Pleistocene Miami Limestone Formation presently consists of the Miami Oolite and the Key Largo Reef facies. The Miami Oolitr facies may be considered as 2 separate units within the Miami Limestone Formation and penecontemporaneous to the Key Largo Reef limestone. The lower unit is called the Key West Oolite and the upper is called the Fort Dallas Oolite. The Fort Dallas unit is considered a eolian dune field formed by the breakdown of various oolitic marine bars across the mouth of Florida Bay (ENP). This new formation was based on field outcrops, above and below the water, the fossils, well cuttings, and an SEM study of the ooids.

Study Type:Quantitative; Gear Type:Probes, short cores; Number of Stations:Variable.

257. Mitterer, R. N. and P. W. Carter. 1977. Some analytical and experimental data on organic-carbonate interaction. IN Proc. Third Internat. Coral Reef Symp., vol.2:geology: 541-548, Miami, Fla.

There are basic differences between the organic matter of carbonate and non-carbonate sediments. Analysis of sediments from offshore Texas show that the carbonate fraction is characterized by (1) coarse size, (2) less total organic matter, (3) a greater proportion of the organic matter as amino acids, and (4) a predominance of aspartic acid. To further elucidate this role, the organic matter of Florida Bay (ENP) sediments were analyzed and found to bind calcium, suggesting that aspartic acid-rich organic matter exerts a strong influence on carbonate geochemistry in the shallow marine environment.

Study Type:Quantitative; Gear Type:Grab; Habitat:Mud; Abiotic Parameters Measured:Grain size distribution, amino acid composition organic carbon, nitrogen, carbonate carbon.

258. Montague, C. L., R. D. Bartleson and J. A. Ley. 1989. Assessment of benthic communities along salinity gradients in northeastern Florida Bay. Final Rept. for NPS Contr. CA 5280-5-8004 to University of Florida and South Florida Water Mgmt. Dist. from South Fla. Res. Center, Everglades National Park, Homestead, FL. 155 pp. + App.

Submerged vegetation and bottom-dwelling animals (benthic communities) were quantified together with aquatic system metabolism and a variety of environmental parameters at twelve stations along three salinity gradients in northeast Florida Bay (ENP), south of the C-111 canal. Scheduled modifications to the canal will likely change the freshwater delivery to this region, thus, the purpose of this assessment was to document the type and development of existing benthic communities and to provide information on how changes in salinity might affect changes in benthic communities in this area. Of the 12 sites, 4 were located in each of the 3 tributary-to-bay systems: 1) the western system (Taylor River/Little Maderia Bay), 2) central system (Snook Creek/Joe Bay/Trout Cove), and 3) the eastern system (Highway Creek/Long Sound/Little Blackwater Sound). Results indicated that benthic community development and metabolism were low as gross primary production was only 188 g-C/$m^2$/yr. Plankton production was higher at upper stations as opposed to outer sites while the reverse was true for numbers of animals and biomass of plants. Salinity variations were believed to account for the depauperate benthic communities at upstream sites. Other environmental conditions did not vary from upstream to outer sites. Environmental differences among the three systems were discussed and, although, severe phosphorous limitations were found, salinity fluctuations were apparently more influential on benthic community development than were nutrients.

Study Period:Pilot study- Mar.through Aug. 1986, Main study- Aug. 1986 through Sep. 1987; Study Type:Quantitative; Gear Type:Vegetation (core/surface sampler), fauna (15 & 10 cm dia. cores, 363 um mesh/20 cm inverted plankton net); Number of Stations:Pilot study-21, Main study-12; Temporal Frequency:Main study-bi-monthly; Biological Component:Flora and fauna; Habitat:ponds, tributaries, open water bays; Abiotic Parameters Measured:Salinity, air & water temp., DO, pH, light, BOD, currents, flow direction, water depth, discharge, nutrients, community respiration, sediment characteristics, wind speed & direction, cloud cover, relative humidity; Dominant Taxa/Taxon Studied:*Thalassia testudinum*, *Pencillus*, polychaetes, mollusks, amphipods, isopods, decapod crustaceans.

259. Montague, C. L., R. D. Bartleson, J. F. Gottgens, J. A. Ley and R. M. Ruble. 1989. The distribution and dynamics of submerged vegetation along gradients of salinity in northeast Florida Bay. Bull. Mar. Sci. (Abstract). 44:521.

The objective of this study is to collect information relevant to the effects of changes in freshwater delivery to northeast Florida Bay (ENP). Submerged vegetation, important for juvenile stages of many fish and shellfish, has been sampled along salinity gradients in three tributary-to-bay transects, each with four stations. Results indicate that the stations differ in both mean salinity and salinity

variation, vegetation in the entire area is sparse (0 to 600 g dry mass/$m^2$), and that the least variable stations have the greatest biomass. The outermost sites are dominated by turtle grass (*Thalassia testudinum*) or calcareous alga *Penicillus*. Dominants at the upstream station change to widgeongrass (*Ruppia maritima*), and the algae *Chara* and *Batophora*. Shoalgrass (*Halodule wrightii*) is common at intermediate stations. Vegetation at upstream stations is dynamic. In March 1986, when salinity was 13 ppt, upstream stations were covered with dense stands of *Ruppia*, *Chara*, and *Batophora*. By May salinity had risen to 26 ppt and the vegetation had disappeared. Despite the return of lower salinities, vegetation at these sites remains sparse.-Adapted from authors' abstract.

260. Moore, J. C. 1955. Bottle-nosed dolphins support remains of young. J. Mamm. 36(3):466-467.

Two bottlenose dolphin were observed in Whitewater Bay (ENP) bumping the head of a baby dolphin along with their snouts. It was suggested that this behavior was the result of an instinct to raise the helpless to the surface to breathe.

Study type:Qualitative; Habitat:Estuarine.

261. Moore, J. C. 1953. The crocodile in the Everglades National Park. Copeia. 1953:54-59.

Observations on the distribution, habitat, nesting habits, and eggs of the crocodile in Florida Bay (ENP) along with additional notes on its natural history and current status are presented. The reproductive success and geographic significance in the discovery of one active nest in Whip Ray Basin is discussed.

Study Period:1949-1951; Study Type:Qualitative; Number of Stations:27 observation sites in ENP; Habitat:Shell-sand beaches; Biological Component:Natural history of the American crocodile: Dominant Taxon/Taxa Studied:*Crocodylus acutus*.

262. Moore, J. C. 1953. Distribution of marine mammals in Florida. Amer. Midl. Nat. 49:117-158.

The distribution of marine mammals was investigated from the reports of the occurrence of seals, manatees, whales and dolphins in Florida waters. The bottlenose dolphin, *Tursiops truncatus*, and the Florida manatee, *Trichurus manatus*, are shown to be present in coastal waters of ENP. Data on strandings of approximately 200 pilot whales in ENP are presented. A key is provided for the identification of marine mammals which occur in Florida waters.

Study Type:Review, qualitative.

263. Moore, J. C. 1956. Observations of manatees in aggregations. Amer. Muse. Nov. 1811:1-24.

Observations made on manatees in ENP during boat patrols revealed little substantial information on their distribution. However, data reported during cold-water induced aggregations at the mouth of the Miami River provided favorable circumstances during winter when warm water outflow occurred from nearby power plants. Scar identification was used to document their presence. Observations on scared (marked) animals over a 5.5 year period demonstrated winter residency among some individuals. Freshwater vs saltwater movements, social organization including play greeting and courtship behavior along with data on maturity, size and reproduction are given.

Study Period:1949-1955; Study Type:Qualitative; Habitat:Estuarine; Dominant Taxon/Taxa Studied:*Trichurus manatus*.

264. Moore, J. C. 1951a. The range of the Florida manatee. Fla. Quar. Journ. of Sci. 14(1):1-17.

Reports of manatee sightings from 1941-1951 serve as the basis for a general distribution of manatees in Florida waters. Northward winter range and coastal warm-season range is discussed. ENP sightings were also reported in Moore (1951b, no. 265 in bibliography).

Study Period:1941-1951; Study Type:Qualitative; Habitat:Brackish (bays & rivers) to fully marine; Biological Component:Marine mammal; Dominant Taxon/Taxa Studied:Florida manatee, *Trichechus manatus*.

265. Moore, J. C. 1951b. The status of the manatee in the Everglades National Park, with notes on its natural history. J. Mamm. 32(1):22-36.

Observations on the numbers, distribution and habitat of the Florida manatee, *Trichechus manatus*, in ENP was presented. They were widely, if not thinly distributed in park coastal waters. Reproduction, feeding care, size, respiration, and food along with mortality from freezes was discussed, although mortality due to illegal hunting for food and entanglement in fish nets was considered to be a more important drain on their numbers.

Study Period:1948-1949; Study Type:Qualitative; Habitat:Brackish (bays and rivers) to fully marine; Dominant Taxon/Taxa Studied:*Trichechus manatus*.

266. Moore, S. A. 1973. Impact of pesticides on phytoplankton in Everglades estuaries. NTIS Rept. No. DI-SFEP-74-15. 100 pp.

In this study 6-hr and 24-hr bioassays were conducted to determine *in situ* the effect of selected organochlorine compounds on natural communities of estuarine phytoplankton in Chokoloskee Bay and in the Lostman's River estuary in ENP. The effect of organochlorine concentration observed was to reduce phytoplankton utilization of bicarbonate thereby also reducing photosynthetic production of organic material. Polychlorinated biphenyls (PCB's:Aroclor 1242, 1245) phytotoxicity occurred at PCB levels less than 5 ug PCB/l.P, p'-DDT phytotoxicity initiated at concentrations of 10 ug DDT/l. Phytotoxicity by dieldrin was inconclusive. No phytotoxicity was observed in Chokoloskee Bay while a typical

dose-response toxicity was observed in Lostman's River and indicated apparent dieldrin toxicity at 15 ug dieldrin/l. Biochemical modes for organochlorine action were discussed in conjunction with difficulties in interpreting the effects of organochlorine compounds to phytoplankton.

Study Period:November 22-28, 1972; Study Type:Quantitative/qualitative; Habitat:Open water bays; Number of Stations:2 (1 in ENP); Number of Replicates/Station:4-5; Biological Component:Phytoplankton; Abiotic Parameters Measured:Salinity, temperature, turbidity.

267. Moore, W. E. 1957. Ecology of Recent Foraminifera in northern Florida Keys. Amer. Assoc. Petr. Geol. Bull. 41:727-741.

No abstract available.

268. Morelock, J. 1970. Consolidation of marine carbonate mud. Geo. Soc. Amer. Progr. Abstr.:861.

In this study, 34 sediment samples from the Gulf of Mexico, Florida Bay, and the Bahama Banks were analyzed to determine their consolidation characteristics. The results were similar to those found by testing noncarbonate silty clay. The carbonate sediments did not compact to as low a porosity as the noncarbonates which could be due to differences in particle shape and strength of the individual particle. Age and incipient cementation must play a part because the Holocene carbonate sediments did not show this characteristic.-Adapted from author's abstract.

269. Morrison, D. 1984. Seasonality of *Batophora oerstedi* (Chlorophyta), a tropical macroalga. Mar. Ecol. Prog. Ser. 14(2):235-244.

The seasonality of *B. oerstedi*, a benthic tropical macroalga, was studied in Florida Bay near Key Largo, adjacent to the eastern boundary of ENP. Abundance, measured by biomass and coverage sampling, varied seasonally with standing crop highest in summer and fall and lowest in winter. Reproductive activity varied seasonally with greatest activity in fall. The fall reproductive pulse can be triggered by a decrease in water temperature. Net photosynthesis (PN) exhibited a unimodal seasonal pattern with highest rates in summer and lowest rates in winter. Net photosynthesis was positively correlated with water temperature. Respiration (R) was elevated in fall during the period of maximal reproductive activity. *Batophora* was capable of year-round growth.

Study Period:July 1978-July 1980; Study Type:Quantitative; Habitat:Canal, bay flat; Number of Stations:3; Biological Component:Macroalga; Abiotic Parameters Measured:Water temperature, DO, nutrients, solar irradiance; Gear Type:Hand; Dominant Taxa/Taxon Studied:*Batophora oerstedi*.

270. Mukherji, K. K. 1989. Holocene development of sandy bank in the western Florida Bay. Bull. Mar. Sci. (Abstract). 44:521.

This study focuses on the key features of mud bank development based on the nature of sediments, internal framework of sedimentary units, floral and faunal community distribution,and $C^{14}$ dates at Sandy Bank on the extreme western edge of Florida Bay (ENP). The sediments are primarily carbonates (90 to 98%) with siliciclastic components constituting 2 to 10% of the sediment which accumulated on a subaerially weathered Pleistocene bedrock surface. Holocene sediments form a shallow submerged bank rising 1 to 2.5 m above the rocky submarine floor. The entire bank surface is carpeted with marine grass including pure stands of *Thalassia*, and mixed communities of Thalassia and Syringodium. The sediments include a mixture of mud (<0.062 mm) and shells (>0.062 mm) with the proportion of mud in the sediments raging from 10 to 98%. Molluscs are the chief skeletal grains and green algae, sponge spicules, foraminifera, radiolaria, etc. may make up a maximum of 5% of the total shell fraction. The principal sediment types, mudstones, wrackstone, and packstone represent approximately 45%, 40%, and 15% of the bank thickness.-Adapted from author's abstract.

271. Muller, G. and J. Muller. 1967. Mineralogisch-Sedimentpetrographische Und Chemische Unterschungen An Einem Bank-Sediment (Cross-Bank) der Florida Bay, U.S.A. N. jb. Miner. Abh. 106(3):257-286.

The sediments of a core of 1.6 m in length taken on the windward side of Cross Bank, Florida Bay (ENP), are divided into two portions, as shown by grain size analysis. A description of each portion is given, along with sediment composition based on changing grain size. Based on a thin layer of sand, a catastrophic event is indicated in the Florida Bay region.-Adapted from English summary obtained from reference no. 272.

272. Multer, H. G. (ed.). 1975. Field guide to some carbonate rock environments; Florida Keys and western Bahamas. Contrib. No. 40., Fairleigh Dickinson Univ., Dept. of Earth Sci., Madison N.J. 175 pp.

This report presents the most recent basic compilation of literature on Holocene sediments in the western Bahamas and in the Florida Keys including the lagoonal areas of Florida Bay which border the mainland of ENP. Selected geologic literature pertinent to local environments is noted within the text, with full bibliographic citations following each subject area. In summary, Holocene sediments of these areas today present a vast array of textures and constituent particles characteristic of environments which have been subjected to fluctuating sea levels and storm action. Such data may be used to interpret ancient environments.

Study Type:Review.

273. Multer, H. G. and J. E. Hoffmeister. 1968. Subaerial laminated crusts of the Florida Keys. Geol. Soc. Amer. Bull. 79:183-192.

Exposed Pleistocene marine limestones of the Florida Keys, including Florida Bay (ENP), are often coated by laminated calcitic crusts. Heretofore these crusts have locally been identified as indurated marine algal stromatolites similar to the soft, marine living algal stromatolitic mats of the Florida Keys, which border and cover

the bedrock; such juxtaposition is now considered merely coincidental. Carbon 14 dating, field relationships, and laboratory evidence indicate subaerial origin. Similar laminated crusts found in subsurface cores suggest emergence followed by submergence of the Key Largo reef during Pleistocene times. Thin crusts may be the only evidence for recognizing some ancient unconformities.-Adapted from authors' abstract in reference no. 272.

274. Nelson, J. E.,Jr. and R. N. Ginsburg. 1986. Calcium carbonate production by epibionts on *Thalassia* in Florida Bay. Journ. Sediment. Petrol. 56(5):622-628.

Annual production of lime mud by two genera of red algae and one genus of serpulid worm was estimated for an area of modern lime mud accumulation in eastern Florida Bay (ENP). The red algae, *Melobesia memranacea* and *Foliella farinosa*, and the serpulid worm, *Sirorbis* sp., live as epibionts on *Thalassia testudinum*, the extensive marine seagrass. The lime mud was estimated by quantifying 1) the life span of *Thalassia*; 2) the abundance of *Thalassia*; and 3) the average amount of epibiont calcium carbonate per blade. The estimate also accounts for both aerial variations in standing crop and seasonal variations in growth rate of *Thalassia*. The results indicate that the estimated annual production of epibiont carbonate is $118 \pm 44$ g/m$^2$/yr, over six times more than the estimated production by the green alga, *Penicillus capitatus*, from the same area (Stockman et al. 1967, no. 398 in bibliography). It can be concluded that the epibionts on *Thalassia* produce significant amounts of lime mud in Florida Bay and,along with algae, probably have been significant contributors since the late Cretaceous.

Study Period:August and December 1983; Study Type:Quantitative; Gear Type:SCUBA, 1/16 m$^2$ grid; Number of Stations:58; Temporal Frequency:3 study periods; Habitat:Seagrass beds; Biological Component:Thalassia blades; Dominant Taxon/Taxa Studied:*Thalassia, Spirobis, Melobesia membranacea, Fosliella farinosa.*

275. Odell, D. K. 1976. Distribution and abundance of marine mammals in south Florida: preliminary results. IN A. Thorhaug and A. Volkes (eds), Biscayne Bay: Past/Present/Future. Symp. No. 1, Spec Rep. 5, Info. Serv., Univ. of Miami Sea Grant Prog. Coral Gables, Fla. Pgs. 203-212.

This paper presents a summary of preliminary results of aerial surveys used to study the distribution and abundance of the bottlenose dolphin, *Tursiops truncatus*, and the manatee, *Trichechus manatus*, in south Florida's coastal waters. The waters of ENP were surveyed from September 1973 through December 1975. Three hundred eighty-five dolphin herds containing 1137 individuals were counted in the park. Herd size ranged from 1 to 25 with a mean of 2.95 animals per herd. Previous data of this type is not available for this area. Possible reasons for differences in dolphin abundances among areas are given. A total of 575 manatees were sighted in the park (5.8 per hr). Over 90% of these sightings were made in Whitewater Bay and inland waters. As with dolphins many of the sightings on successive flights were probably the same individuals. As little life history information is available for these species, a research program is proposed to assure the conservation and well-being of both species.

Study Period:September 1973 - December 1975; Study Type:Qualitative; Gear Type:Light aircraft; Temporal Frequency:Flights made every two weeks over the same flight path; Number of Replicates/Station:Forty flights (100 survey hrs); Habitat:Water column; Biological Component:Marine mammals; Dominant Taxon/ Taxa Studied:*Tursiops truncatus, Trichechus mantus.*

276. Odell, D. K. 1976. Distribution and abundance of marine mammals in the waters of Everglades National Park. Pgs. 673-681. IN R. M. Linn, ed., Proceedings of the First Conf. on Sci. Res. in the Nat. Parks. Trans. Natl. Park Serv. 5, U.S. Dep. Inter.

This study presents the preliminary results of aerial surveys used to assess the distribution and abundance of the bottlenose dolphin, *Tursiops truncatus*, and the West Indian Manatee in the waters of ENP. From September 1973 through June 1976, 46 survey flights were completed resulting in a total of 13,156 air miles surveyed. Five hundred seventy-three dolphin herds totaling 1651 individuals were sighted. Mean herd size was 2.9 animals. Both group and individual foraging activities were noted; mullet was the only prey species identified. Most dolphin sightings were in the Gulf of Mexico and in Whitewater Bay. Dolphins were less abundant September - November. Dolphins were more abundant in the park than in Biscayne Bay. Three hundred two manatee herds totalling 772 individuals were sighted. Most manatee sightings were in Whitewater Bay. Too little is known on their movements to assess seasonal distribution. Previous data of this type is not available from other areas. Other marine mammals observed in ENP include Fin whale, *Balaenopters physalus*; sperm whale, *Physeter macrocephalus*; and false killer whale, *Pseudorca crassidens.*

Study Period:September 1973 through June 1976; Study Type:Qualitative; Gear Type:Light aircraft; Temporal Frequency:46 flights/ 3 hrs each, covering 13,156 air miles; Habitat:Water column; Dominant Taxon/Taxa Studied:*Tursiops truncatus.*

277. Odell, D. K. 1975. Status and aspects of the life history of the bottlenose dolphin, *Tursiops truncatus*, in Florida. J. Fish. Res. Bd. Can. 32(7):1055-1058.

This study reports on the life history aspects of the Bottlenose dolphin, *Tursiops truncatus*, in Florida's coastal waters. Data for ENP are as presented in Odell 1976 (no. 276 in bibliography).

278. Odell, D. K. , E. D. Asper, J. Baucom and L. H. Cornell. 1980. A recurrent mass stranding of the false killer whale, *Pseudorca crassidens*, in Florida. Fish. Bull. U.S. 78:171-177.

This report provides information on mass strandings of *Pseudorca crassidens* in Florida waters. In ENP, 20 carcasses of *P. crassidens* were discovered on Cape Sable. Sex determination and external measurements were not possible due to severe decomposition.

Study Type:Quantitative, qualitative; Habitat:Open water, beaches.

279. Odell, D. K. and E. D. Asper. 1977. A summary of information derived from a mass stranding of *P.crassidens* in Florida, 1976. Marine Mammal Stranding Workshop, Athens, Ga., 10-12 Aug., 1977, p.20-21. U.S. Mar. Mam. Comm. contr. MM7ACO20. (Abstract only)

This paper summarizes information collected during mass strandings of *Pseudorca crassidens* in Florida. Within ENP, information is as presented in Odell et al. 1980 (no. 278 in bibliography).

280. Odell, D. K., E. D. Asper, J. Baucom and L. H. Cornell. 1979. A summary of information derived from the recent mass stranding of a herd of false killer whales, *Pseudorca crassidens* (Cetacea:Delphinidae). IN J.R. Geraci and D.J. St. Aubin (eds). Biology of marine mammals: insights through strandings, p 207-222., NTIS Rept. PB293-380.

Within ENP, the narrative is the same as in reference no. 278.

281. Odum, W. E. 1969. Pathways of energy flow in a South Florida estuary. Ph.D. Dissert., Univ. of Miami, Coral Gables, Fla. 162 pp.

Also publ. as: Sea Grant Tech. Bull. No. 7, Univ. of Miami Sea Grant Prog., Miami, Fl. 1-162 p. (1971).

A study of energy flow in a mangrove ecosystem was conducted in the North River basin (ENP) between 1967 and 1969. The analysis of the stomach contents of more than eighty species of animals revealed that phytoplankton and benthic algae were minor food sources compared to the annual production of mangrove leaves. A food web based on the bacterial and fungal degradation of vascular plant material, originating principally from red mangrove leaves, into organic detritus is developed, from detritus consumers to gamefish and wading birds at the highest trophic levels. The effect of large scale destruction or removable of mangroves on the trophic structure is discussed.

Study Period:1967-1969; Study Type:Qualitative, quantitative; Gear Types:Nets, trawls, hook & line, cores; Biological Component:Flora and fauna; Number of Stations:Five; Temporal Frequency:Monthly; Number of Replicates/Station:3-5 consecutive days/monthly; Abiotic Parameters Measured:Salinity, temperature, water level; Dominant Taxon/Taxa Studied:Tidewater silverside, *Menidia beryllina*; code goby, *Gobiosoma robustum*; crested goby, *Lophogobius cyprinoides*.

282. Odum, W. E. and E. J. Heald. 1972. Trophic analyses of an estuarine mangrove community. Bull Mar. Sci. 22:671-738.

This study was conducted from 1967 to 1969 in the North River Basin of ENP, a mangrove region supporting large populations of birds, gamefishes, and invertebrate species, to determine the energy basis of these species and to delineate the routes by which energy is transferred through the food web. This paper consists of summaries of food habits for most of the fish and invertebrate species

which occur in the North River mangrove ecosystem. Pertinent information on foods of these species from other publications has been summarized. For most species there is an estimate of relative importance in terms of abundance.

Study Period:1967 to 1969; Study Type:Quantitative; Gear Types:Nets, trawls, traps, hook & line, fish poisons, grabs, dredges; Number of Stations:Five (see Odum 1969, no. 281 in bibliography); Habitat:Mangrove, water column; Biological Component:Fauna; Abiotic Parameters Measured:Salinity (see Odum, 1971, no. 281 in bibliography); Dominant Taxon/Taxa Studied:Tidewater silversides, *Menidia beryllina*; Code goby, *Gobiosoma robustum*; silver jenny, *Eucinostomus gula*.

283. Odum, W. E., C. C. McIvor and T. G. Smith. 1982. The ecology of the mangroves of South Florida: a community profile. U.S. Fish and Wildl. Serv., OBS, Washington, D.C. FWS/OBS-81/24. 144 pp.

This review presents a detailed description of the community structure and ecosystem processes of the mangrove forests of south Florida with much of the acreage of mangroves in Florida (430,000-500,000) found within the boundaries of ENP. This description is based upon a compilation of data and hypotheses from published and unpublished sources. Information covered ranges from details of mangrove distribution, primary production, and diseases to aspects of reproduction, biomass partitioning, and adaptations to stress. Mangrove ecosystems are considered in terms of zonation, succession, litter fall and decomposition, carbon export, and energy flow. Most of the components of mangrove communities are cataloged and summarized; these include microorganisms, plants other than mangroves, invertebrates, fishes, reptiles, amphibians, birds, and mammals. The value of mangrove ecosystems to man and ways to manage this resource are discussed.

Study Type:Biological review; Biological Component:Mangroves.

284. Ogden, J. C. 1978. American crocodile. Pgs. 21-22 IN R.W. McDiarmid, ed. Rare and endangered biota of Florida. Vol.3, Amphibians and Reptiles. Univ. of Fla. Press. Gainesville.

This paper presents a summary of information on the life history, ecology, and population numbers of the American crocodile in Florida, principally within the boundaries of ENP (Florida Bay and the adjacent mainland).

Study Type:Biological review.

285. Ogden, J. C. 1978. Status and nesting biology of the American crocodile, *Crocodylus acutus* (Reptilia:Crocodilidae) in Florida. J. Herp. 12(2):183-196.

This study was conducted between 1968 and 1975, primarily in Florida Bay (ENP), and was designed to measure the size and range, general habitat characteristics and factors regulating nesting success of *C. acutus*. These data are intended to update and supplement those presented by Moore (1953, no. 262 in bibliography). Results indicate that the nesting range has been considerably reduced including continued reduction in Florida Bay since it became a part of ENP in 1950.

Crocodiles in this area are mound nesters, utilizing beaches, creek banks, and canal levees as nesting sites. Females maintain mounds that are used repeatedly over many years. Mean clutch size is 44; about 48% of the eggs hatch in successful nests. Nesting failures are due to racoon predation and temperature problems in certain types of nests. Population numbers of crocodiles may have ranged between 1,000 and 2,000 during the early 1900's, but that total has declined to the present range of between 100 and 400 animals. Factors that regulate the population are discussed.

Study Period:1968-1975; Study Type:Qualitative; Number of Stations:Ten nesting sites; Habitat:Beaches, creek banks;Biological Component:Marine reptile (Crocodilean); Abiotic Parameters Measured:Nest temperature; Dominant Taxon/Taxa Studied:*Crocodylus acutus*.

286. Ogden, J. C., W. B., Jr. Robertson, G. E. Davis and T. W. Schmidt. 1974. Pesticides, polychlorinated biphenols and heavy metals in upper food chain levels, Everglades National Park and vicinity. U.S. Dep. Comm., NTIS Rept. No. DI SFEP-74-16. 27 pp.

A general concern over possible environmental pollution by man-made poisons prompted the extensive study of chlorinated insecticides, polychlorinated biphenyls, and trace metals in upper trophic levels of material collected in and adjacent to ENP. Collections, made between 1971 and 1973 and analyzed by WARF, Inc., provide a baseline for future analyses, and clues for particular poisons or particular species in need of more study. These indicated that DDT, DDE, DDD, Dieldrin and PCB's exist in concentrations well below amounts below amounts known to have either acute or chronic effects. Less is known of the significance of the various metal concentrations reported here, although levels of mercury in freshwater vertebrates and arsenic in marine species are great enough to deserve more intensive study.

Study Period:1971-1973; Study Type:Qualitative; Habitat:Mangrove, water column; Biological Component:Fauna; Dominant Taxon/Taxa Studied:White Ibis, egret, alligator, crocodile, pinfish, catfish, mullet, gray snapper, spiny lobster, pink shrimp, stone crab.

287. Olmstead, I. C., L. L. Loope and R. P. Russell. 1981. Vegetation of the southern coastal region of Everglades National Park between Flamingo and Joe Bay. Rept. T-620. Homestead, Fla., Everglades N.P., South Florida Research Center. 18 pp.

The relative inaccessibility and inhospitality of the mangrove environment, and the brevity of ecological studies due to human lifetimes in relation to processes involved were some of the reasons given for the paucity of detailed knowledge of specific change in the mangrove environment. This mapping project was initiated toward acquiring baseline information to allow workers for interpreting change in the mangrove zone of ENP. Changes in mangrove vegetation due to hurricane destruction and silt deposition, freezing temperatures, sea level rise/fall, and input of freshwater from rainfall and runoff were discussed. Also, a description of floristic composition and structure of mapped units along with species lists for several hammocks were provided.

Study Period:1978-1980; Study Type:Quantitative, qualitative; Gear Type:Color aerial photography (1978), USGS orthophotomaps, ground-truthing techniques; Habitat:Coastal mangrove; Dominant Taxon/Taxa Studied:*Rhizophora mangle*.

288. Overstreet, R. M. 1966. Parasites of the inshore lizardfish, *Synodus foetens*, from south Florida. M.S. Thesis, Univ. of Miami, Miami, Fla. 69 pp.

The parasites of the inshore lizardfish, *Synodus foetens*, were studied from samples collected at the Buttonwood Canal (ENP) entrance to Flamingo, from January 1963 to December 1964. Monthly size frequencies indicated that all fish were less than one-year old, and all specimens were infected by one or more species of parasites. Parasite location in the host and parasite associations are discussed.

Study Period:January 1963-December 1964; Study Type:Qualitative; Habitat:water column; Gear Type:Channel net; Temporal Frequency:Monthly: Number of Stations:One; Biological Component:Water column fish; Abiotic Parameters Measured:Salinity, temperature; Dominant Taxon/Taxa Studied:Inshore lizardfish, *Synodus foetens*.

289. Overstreet, R. M. 1968. Parasites of the inshore lizardfish, *Synodus foetens*, from south Florida, including a description of a new genus of Cestoda. Bull. Mar. Sci. 18:444-470.

Narrative same as in reference no. 288.

290. Parker, G. G. and C. W. Cooke. 1944. Late Cenozoic geology of southern Florida with a discussion of the ground water. Fla. Bur. Geol. Bull. No. 27.

Southern Florida gives evidence of repeated oscillations of sea level but of little structural deformation. The oldest outcropping formations in the Everglades area is the Tamiami formation consisting of calcareous sandstone and sandy limestone with beds and pockets of quartz sand. It is separated from overlying Pleistocene formations by an erosional unconformity which indicates that it was above sea level during middle and late Pliocene time. Over 60 exploratory test wells scattered over southeast Florida were sunk for the purpose of obtaining data on the occurrence of water which was dependent on the geology of the area. Because water resources in Dade County were related to the Everglades, research was extended west to the Gulf of Mexico and north to Lake Okeechobee. Topographic-ecologic divisions pertaining to what is now ENP were described including general features, the floor, origin, and drainage patterns in the Everglades and along the coastal ridge as well as coastal marshes and mangrove swamps. A historical summary, development, and water-bearing characteristics of each Pliocene and Pleistocene rock formation was given.

Study Type:Qualitative, quantitative; Gear Type:Test wells; Abiotic Parameters Measured:Sediment characteristics, tide level.

291. Parkinson, R. W. 1985. Holocene sedimentation and coastal response to rising sea level along a low energy coastline, southwest Florida. Geo. Soc. Am., Abstr. Prog. 17:685.

Although classified as a low energy coastline, evidence of marine transgression along the Ten Thousand Islands area (Lopez River/Chokoloskee Bay area in ENP) can ultimately be preserved as coarse skeletal and siliciclastic sands which unconformably overlie basal mangrove peats. The low energy classification is based on average wave height; winter storms and hurricanes can significantly modify prevailing processes and sedimentation products. Wind generated wave action, supply of quartz sand, and biological productivity are responsible for the composition and distribution of sediment in the study area. Cores taken seaward of the study area reveal a sediment sequence consisting of basal peat overlain by coarse-grained skeletal and siliciclastic sand thus indicating what might be preserved in the sedimentary record of marine transgression over "low energy" coastal systems in the geologic past.-Adapted from author's abstract.

292. Parkinson, R. W. 1987. Holocene sedimentation and coastal response to rising sea level along a subtropical, low energy coast, the Ten Thousand Islands, southwest Florida. Ph.D. Dissertation, Univ. of Miami, Coral Gables, Fla. 224 pp.

Surface and subsurface sampling in a variety of Holocene sedimentary environments of the Ten Thousand Islands (from the Lopez River in ENP to Cape Romano) have indicated changing rates of Holocene sea level rise based on coastal stratigraphy and carbon-14 dating analysis. An initial, rapid rise (prior to 3,500 years before present), which averaged 26 cm/ 100 years, prompted shoreline retreat; when the rise slowed to an average of 10 cm/100 yrs biological sediment production outpaced the transgressive effects of sea level rise, thus transforming subtidal areas into emergent (island - mangrove forest) areas. The results of this study have application to the predicted sea level rise that will accompany global warming. For example, the EPA has predicted a minimum of 56 cm sea level rise by the year 2100, thus the author suggests that shoreline retreat will accompany the sea level rise predicted by the EPA.

Study Period:1985-1986; Study Type:Qualitative, quantitative; Habitat:Tidal channels, bays, open Gulf waters, Indian shell middens, mangrove islands; Gear Type:Grab and hand samples, vibracores; Number of Stations:34 grab and hand sites (10 in ENP), 40 vibracore transects/sites (18 in ENP); Biological Component:Flora & fauna; Abiotic Parameters Measured:Water depth, wave height, current velocity, substrate consistency and description, sediment composition, grain-size, carbonate mineralogy.

293. Parks, J. M., P. J. Lagas, M. A. Cable, R. D. Becker, S. I. Michelson, C. Lensch and E. B. Evenson. 1982. Florida Bay carbonate mud banks: possible additional factor in mode of deposition exemplified by Ramshorn Spit. Geol. Soc. Am., Abstr. Progr. 14(7):58.

Holocene carbonate mudbanks in Florida Bay (ENP) have been attributed to the turtle grass, *Thalassia testudinum*, which traps fine sediment on contact with slime coating on its leaves, acts as a baffle to promote the deposition of suspended sediment by slowing current flow, and prevents sediment erosion with its rhizomes.

However, Ramshorn Spit (ENP) is accumulating without benefit of a grass cover. Older portions of the spit that have built up to sea level acquire a grass cover which stabilizes the mudbank. Results indicate that sediment comes to rest on the growing mudspit as organically-bound agglomerates. Undispersed samples are unimodal at 4.50, have a lower density than solid particles of that size, and therefore settle more slowly. Most previous size analysis of Florida Bay sediments were made on mechanically and/or chemically disaggregated samples; this may have obscured the observation that Ramshorn Spit sediment is deposited as aggregates of fine particles bound with organic matter.-Adapted from authors' abstract.

294. Perkins, R. D. 1977. Quarternary sedimentation in south Florida. Part II. Depositional framework of pleistocene rocks in south Florida. U.S. Geol. Surv. Mem. 147:131-197.

Detailed stratigraphic analysis of the Pleistocene of south Florida, based on 56 stations, 6 of which were located in the coastal waters of ENP, indicates that these deposits are divisible into five marine units and are correlated with eustatic high sea-level stands and discontinuity surfaces with subaerial exposure during low stands. Each marine unit is described and analyzed from role of pre-unit topography, isopach patterns, lithofacies patterns, ecologic facies patterns, and interpretation of depositional environments. Considered as a whole, the Pleistocene record of south Florida may be thought of as a simple infilling of pre-Pleistocene paleotopography during repeated regressions, modified by subaerial exposure and the production of discontinuity surfaces low sea-level stands.

Study Type:Quantitative; Number of Stations:56 (6 in ENP); Habitat:Estuarine; Gear Type:Cores; Abiotic Parameters Measured:Water depth, sediment characteristics.

295. Perkins, R. D. and P. Enos. 1968. Hurricane Betsy in the Florida-Bahamas area: geologic effects and comparison with Hurricane Donna. J. Geol. 76:710-717.

Within a five year period (1960-1965) two violent hurricanes, Donna and Betsy, passed over the Florida Keys. Although they were of comparable size and intensity, their geologic effects differed. Both damaged the outer reefs extensively, although Donna had already removed the weaker elements before Betsy struck. In Florida Bay (ENP) supratidal sedimentation on the islands and mainland was extensive during Donna, but almost absent during Betsy. An exception to this was the deposition of spillover lobes of skeletal sand landward of the beach of Cape Sable.-Adapted from an abstract obtained from a report on the geology of ENP. (See reference no. 519).

296. Perkins, R. D., M. D. McKenzie and P. L. Blackwelder. 1972. Aragonite crystals within codiacean algae: Distinctive morphology and sedimentary implications. Science 175(4022):624-626.

Bottom sediments and cores of mud banks taken from, principally, the shallow waters of Florida Bay (ENP),were used to conduct studies of single crystals of aragonite within Codiaece algae which revealed characteristic crystal forms

produced by two distinctly different modes of calcification. Diagnostic serrated crystals (1 micrometer in length) of aragonite originating within the extracellular sheaths of capitular filaments are incorporated into modern lime sediments. Intracellular calcification within *Penicillus dumetoses*, previously unreported,is represented by doubly terminated aragonite crystals ranging in size from 48 to 160 micrometers.

Study Type:Qualitative; Gear Type:Cores; Habitat:Surface and subsurface lime muds; Biological Component:Codiaece algae; Abiotic Parameters Measured:Sediment characteristics; Dominant Taxon/Taxa Studied:*Penicillus dumetosus*, *P. capitatus*, *Udotea* sp., *Rhipocephalus* sp.

297. Perlmutter, M. A. 1979. Recognition of storm produced layering in the Ten Thousand Islands region of southwest Florida. Geol. Soc. Am. Abstr. 11(7):493-494.

A study of the storm produced layering in the sedimentary accumulate of the Ten Thousand Islands area (ENP) is described. Storm layers contain significant variation in texture, composition, color, bed thickness, and internal structure, but are consistent within each of the sub-environments within the study area. Storm layers are described for open Gulf waters, channels, larger bays adjacent to the coast, and smaller enclosed bays.-Adapted from author's abstract.

298. Perlmutter, M. A. 1982. The recognition and reconstruction of storm sedimentation in the nearshore, Southwest Florida. Ph.D. Dissertation, Univ Miami, Coral Gables. 199 pp.

The Ten Thousand Islands region is composed of three subtidal environments: (1) shallow coastal lagoons; (2) tidal channels; and (3) small protected bays formed by the shapes of mangrove islands. Coring and probing studies in each of the sub-environments from Cape Romano to the Lopez River (ENP) have revealed that subsurface sediments are primarily alternating zones of bioturbated, shelly, sandy mud, 5-50 cm in thickness, and coarse layers of quartz sand and shell material, 1-23 cm in thickness. In each sub-environment, the surface sediments exhibit a characteristic texture and composition caused by local variations in energy levels and shell production. Coarse layers are deposited during major hurricanes. Four basic types of coarse layers are presented. The preservation of these coarse layers depends upon several factors: (1) sediment availability; (2) time interval between hurricanes; (3) hurricane strength; (4) the depth of burial by post-storm settleout; and (5) sea level rise. Mollusk shells in surface sediments are divided into three assemblages, reflecting onshore to offshore geohydrological conditions.

Study Type:Qualitative, quantitative; Gear Type:Cores, metal probing rod, sediment plots/traps; Number of Stations:150 coring sites/22 in ENP; Habitat:subsurface sediment layers; Biological Component:Mollusks, amphipods, isopods; Abiotic Parameters Measured:Water depth, sediment composition, grain size.

299. Perrine, D. 1987. Some possible effects of the declawing of female stone crabs, *Menippe mercenaria*. M.S. Thesis, Univ. of Miami, Coral Gables, Fla.

Sixty female stone crabs (*Menippe mercenaria*) collected from the Cape Sable - Florida Bay area (ENP), October 1984 through February 1985, were paired and held in large tanks with running sea water. During a 4-month period declawed crabs produced more egg masses than crabs with claws which was significant for the first three months. The spawning season is approximately April - September. Molting which occurs in mature females in fall - winter after spawning can be accelerated by removal of claws early in the intermolt period. The increase in spawning by declawed crabs during the early months of the spawning season may be a result of interactions between the molting and spawning cycles, with both processes shifted forward in time as a reaction to declawing.

Study Period:October 1984-February 1985; Study Type:Quantitative, qualitative; Gear Type:Crab traps; Habitat:Natural (Cape Sable hard bottom), Artificial (aquariums);Biological Component:Decapod crustacean/crab; Dominant Taxon/Taxa Studied:*Menippe mercenaria*.

300. Pierce, E. L. 1965. The distribution of lancelots (Amphioxi) along the coasts of Florida. Bull. Mar. Sci. 15:480-494.

The distribution of lancelots (Amphioxi) was studied in nearshore areas along both coasts of Florida (including ENP) by sand dredge, principally during the summers of 1961-62. A single species, *Branchiostomus caribaeum*, was found, occurring at times, in excess of 15/liter of sand. The largest numbers were found from Cape Sable to Cedar Key. The east coast, Indian River, and the Florida Keys yielded few or no specimens. The peninsular West coast area provides a more favorable environment than do other areas studied. The southernmost catches occurred in ENP (Mormon Key). Areas of higher concentrations were characterized by clean, silicious sand with shell fragments, tidal currents, salinities between 22-35 ppt, and abundant phytoplankton.

Study Period:1960-1964; Study Type:Semi-quantitative; Gear Type:plankton nets, sand dredge; Number of Stations:704 (Approx. 80 from Ten Thousand Islands to Key West; Abiotic Parameters Measured:Salinity, temperature, water depth, current speed; Dominant Taxon/Taxa Studied:*Branchiostoma caribaeum*.

301. Pike, S. 1988. Computer simulation of configuration and sea level changes in Florida Bay. M.S. Thesis, Wichita State Univ., Wichita, Kans. 170 pp.

Florida Bay has been the site of numerous sedimentological studies since it was discovered that in situ calcium carbonate is being deposited there. A quantitative process-simulation model of the Florida Bay portion of ENP was developed using basic data from previous studies. Stockman et al. (1967, no. 398 in bibliography), and Nelsen and Ginsburg (1986, no. 274) provided the rates of production of carbonate mud in the Bay and a sea level curve for the last 5000 years derived by Robbin of the USGS, Miami Beach, Fl, was utilized to simulate the change in water depth. The study was done to be able to predict possible future configurations of the Bay with different topographic, structural, and sea level changes. Recently discussions have focused on whether Florida Bay is filling in with sediment or eroding, and whether sea level is rising faster than the rate of accumulation. The three main features of this simulation are: (1) use of a modified Holocene sea level curve, (2) different rates of generation and accumulation of carbonate mud, and (3)

tilting of the Bay to the SW at variable rates. By differing the three variables, it is possible to project forward in time to predict future conditions. The study determined that sea level was the major factor simulated, in controlling the configuration of the Bay and that the Bay is filling in with sediment from the north and west.

Study Type:Quantitative; Gear Type:Charts (NOAA navigational), computer programs (using Zenith Z-100 and adaptable for IBM-PC compatibles), sea level curve calculations; Abiotic Parameters Measured:Sediment characteristics.

302. Powell, A. B., D. E. Hoss, W. F.,Jr. Hettler, D. S. Peters, L. Simoneaux and S. Wagner. 1987. Abundance and distribution of ichthyoplankton in Florida Bay and adjacent waters. Rept. SFRC-87/01. Homestead, Fla., Everglades N.P., South Florida Research Center.

An ichthyoplankton survey was carried out in Florida Bay (ENP),and adjacent waters that focused on the abundance and distribution of larvae of four target species--red drum (*Sciaenops ocellata*), snook (*Centropomus undecimalis*), gray snapper (*Lutjanus griseus*), and spotted seatrout (*Cynoscion nebulous*). Twenty sampling stations were established--eight to document larval entry into Florida Bay and adjacent waters, and 12 within Florida Bay and adjacent waters--to provide insight into larval fish distribution and movement. Spotted seatrout was the only target species whose larvae were regularly collected. No snook, one red drum and 16 potential gray snapper were collected. Results indicated that seatrout spawn in intermediate to high salinity within western Florida Bay. Snapper larvae were found in the Atlantic Ocean, but not in park waters, while juveniles were found in both Florida Bay and the Atlantic Ocean. Data was provided on the distribution and abundance of non-gamefish within the study area; gobiid larvae dominated the catch. This report also presented information on the development and design of bongo plankton nets for use in shallow water. The device is portable, detachable and can be used in water as shallow as 1.5 m.

Study Period:March 1984-September 1985, Study Type:Qualitative, quantitative; Gear Type:Bongo nets/333 um mesh; Number of Stations:20; Number of Replicate/Station:4; Temporal Frequency:Monthly; Habitat:Water column; Biological Component:Ichthyoplankton; Abiotic Parameters Measured:Salinity, temperature; Dominant Taxon/Taxa Studied:Spotted seatrout, gobiid larvae.

303. Powell, A. B., D. E. Hoss, W. F.,Jr. Hettler, D. S. Peters and S. Wagner. 1989. Distribution and abundance of ichthyoplankton in Florida Bay and adjacent waters. Bull. Mar Sci. 44:35-48.

An ichthyoplankton survey in Florida Bay (ENP) and adjacent waters focused on the abundance and distribution of larvae of four species-red drum (*Sciaenops ocellata*), snook (*Centropomus undecimalis*), gray snapper (*Lutjanus griseus*), and spotted seatrout (*Cynoscion nebulous*). Spotted seatrout was the only target species whose larvae were regularly collected. Results indicated that this species spawned in intermediate to high salinity waters within western Florida Bay and adjacent estuarine waters, but not in brackish waters and that spawning was protracted. Snapper larvae were found in the Atlantic Ocean, but not in park waters whereas juveniles occurred both in Florida Bay and the Atlantic Ocean.

They apparently spawn offshore in summer and at least some enter Florida Bay as advanced larvae or juveniles. Data is presented on the distribution and abundance of the total ichthyoplankton fauna in Florida Bay and adjacent waters; gobiid larvae dominated the catch.

Study Period:March 1984-September 1985; Study Type:Qualitative, quantitative; Gear Type:Bongo nets/333 micron mesh; Number of Stations:20; Number of Replicates/Station:4; Temporal Frequency:Monthly; Habitat:Water column; Biological Component:Ichthyoplankton; Abiotic Parameters Measured:Salinity, temperature; Dominant Taxon/Taxa Studied:*Cynoscion nebulous*, gobiid larvae.

304. Powell, G. V. N., J. G. Holmquist and S. M. Sogard. 1989. Physical and environmental characteristics of Florida Bay with emphasis on mud banks. Bull. Mar. Sci. (Abstract). 44:522.

Florida Bay (ENP) is divided into basins by a latticework of mud banks which represent most of the bay's sediment, support half of the bay's seagrass standing crop, provide almost all of the bay's wading birds' foraging habitat, and function as barriers to circulation, dividing the area into sub-environments. Physical characteristics which affect plant and animal communities and define 3 distinct ecological periods in Florida Bay include banks with sheltered and exposed sides of coarse and fine sediments, low and high organics, water levels, and lunar tidal flux. Bank and basin temperature ranges are given. The banks are the stage for complex interaction of physical forces; much of this interplay would be attenuated in the deeper grassbeds that have been the subject of most previous studies.

305. Powell, G. V. N., J. Kenworthy and J. W. Fourqurean. 1989. Experimental evidence for nutrient limitation of seagrass growth in a tropical estuary with restricted circulation. Bull. Mar. Sci. 44:324-340.

The impacts of additions of nutrients to a seagrass community on a carbonate mud bank in Florida Bay (ENP) was investigated from 1983-1987. Shallow mud banks dampen lunar tides in Florida Bay, and impoundment and channelization of the Everglades watershed have reduced freshwater inflow, resulting in restricted circulation and reduced nutrient availability. Nutrient additions supplied by defecating seabirds from experimental roosts significantly increased areal leaf production and standing crop of *Thalassia testudinum* and *Halodule wrightii*. It was concluded from tissue nutrient content and nitrogen fixation assays that phosphorous availability limits seagrass growth in unenriched conditions, but that nitrogen becomes limiting with the addition of bird excrement.

Study Period:4 years; Study Type:Quantitative; Gear Type:Stakes(PVC pipes/wooden blocks), variable-sized quadrats, cores, leaf markings, platform collectors; Temporal Frequency:Variable; Number of Stations:5; Habitat:Water column, sediment, seagrass beds; Biological Component:Bird excrement (Royal Terns, Cormorants), seagrasses (*Thalassia, Halodule*); Abiotic Parameters Measured:Water depth, pore water nutrients; Dominant Taxon/Taxa Studied:*Thalassia, Halodule*.

306. Powell, G. V. N., S. M. Sogard and J. G. Holmquist. 1987. Ecology of shallow water bank habitats in Florida Bay. Final Rept. CX 5280-3-2339 to South Florida Research Center, ENP from Natl. Audu. Soc., Tavernier, Fl. 406 pp.

This study was designed to describe the physical environment of Florida Bay's (ENP) bank habitats, including topography, tidal flux, wind direction and velocity, temperature and salinity regimes, sediment characteristics, and seasonal variations of the above. In addition, the distribution and abundance of fishes and decapod crustaceans and variation in seagrass growth on banks was determined. The effects of seagrass parameters and variations in physical parameters on species composition and density was determined. The effects of nutrients on seagrass parameters, fish and invertebrates was presented. Results indicated that bank seagrass communities were affected to a greater degree than submerged systems. Standing crop of seagrasses was the most important biotic factor influencing fish and decapod densities. Water level and wind stress had a major impact on the shallow banks. Seagrass, demersal fish, pelagic fish, and decapod populations on the banks varied in a consistent manner across the bay. Seagrass cover on banks allowed species to survive during periods of extreme physical stress and insured a source of prey for fish and birds.

Study Period:1984-1986; Study Type:Quantitative; Gear Types:Throw traps, nets, cores; Number of Stations:7; Temporal Frequency:3 x annually by season; Number of Replicates/Station:Varied (6-12); Habitat:Mud, water column; Biological Component:Pelagic and demersal fish, decapod crustaceans, seagrasses; Abiotic Parameters Measured: Salinity, temperature, water level, sediment; Dominant Taxon/Taxa Studied:Clupeidae, Ariidae, Gerridae, Palaeomonidae, *Thalassia*.

307. Price, W. A. 1964. Cyclic cuspate sand spits and sediment transport efficiency. J. Geol. 72(6):876-880.

Contrasts in the occurrence of cyclic cuspate spits are found (1) between a smooth, sandy oceanic barrier shoreline and spit-decorated shorelines of the associated narrow barrier lagoon; (2) In spit development varying from none on a straight sandy shoreline to progressively prominent development with increasing convexity along an adjoining sandy headland. Critical factors in this selectivity seem to be wave fetch and shoreline curvature. Example of sandy cuspate foreland and small sandy foreland - Cape Sable (ENP).-Adapted from an abstract obtained from a report on the geology of ENP. (See reference no. 519.)

308. Price, W. A. 1967. Development of the Basin-Basin honeycomb of Florida Bay and the northern Cuban Lagoon. Trans. Gulf Coast Assoc. Geol. Soc. 17:368-399.

A geomorphological synthesis of geological and ecological data on Florida Bay is provided by the author as follows: Florida Bay (ENP) a triangular 1,000-sq mile, bimodally windy, sub-tropical lagoon is a honey comb of closely spaced, interconnecting, sub-oval, pan-shaped basins individually upwards of 10 miles long and 12 feet deep. It lies north-south between mangrove swamp belts along the mainland of ENP and the emergent barrier reef of the Florida Keys. Basin walls of Holocene marl made stable by alterations of mangrove swamp bands and

marine grasses form a honeycomb pattern trough the lagoon. Basin areas and depths increase irregularly southward. No process of accumulation adequate by itself to form such honeycombs is known. The genetic process was the drowning and embayment of oriented lakes formed in drowned marsh rills.

Study Type:Quantitative; Gear Type:Geographic and bathymetric mapping.

309. Quinn, T. M. 1984. Evolution of selected Holocene mangrove islands of west-central Florida Bay. M.S. Thesis, Wichita State Univ., Wichita, Kans. 144 pp.

In the Florida Bay portion of ENP, calcium carbonate is being produced in situ by a variety of green algae, whereas the remainder of the sediment is composed of molluscan-Foraminifera shell-fragments. This sediment is being deposited unconformably on the surface of the southwestwardly gently sloping Pleistocene Miami Limestone. The variability in the stratigraphic history of the Holocene mangrove-fringed islands of the Bay, as revealed by numerous cores, suggests that there may be fundamental differences in the processes involved in island evolution between islands that developed in northeastern and north Florida Bay than from those islands that developed in west-central Florida Bay. This suggests a revised model for carbonate-sediment deposition in the area of west-central Florida Bay. The sedimentary record and principal sedimentary environments in this area in upward succession are: 1) freshwater carbonate mud, 2) a transgressive peat, 3) molluscan packstone unit, 4) supratidal mudstone, that developed from a coastal tidal flat where the rate of deposition was greater than the rate of Holocene sea level rise. The author concludes that island evolution as a function of mangrove colonization of mudbanks is a more recent phenomena, and that islands that formed earlier in the history of the marine inundation of the Bay in west-central Florida Bay nucleated from a coastal tidal flat that developed on a transgressive peat.

Study Type:Quantitative; Gear Type:Hand-operated coring device; Number of Stations:2 island transects, 10 single core nontransected island sites, Temporal Frequency:Once; Habitat:Island mud/peat; Abiotic Parameters Measured:Depth to bedrock from sample site; radiocarbon age determinations; Biological Component:Flora & fauna; Dominant Taxon/Taxa Studied:Mollusks, mangrove peat.

310. Quinn, T. M. and D. F. Merriam. 1988. Evolution of Florida Bay islands from a supratidal precursor; evidence from westernmost Bob Allen Key and Sid Key. J.Geol. 96(3):375-381.

Cores from the interior portions of westernmost Bob Allen Key and Sid Key (Florida Bay ENP) document island nucleation from a supratidal precursor developed on a paralic peat deposit; whereas cores from exterior portions of these islands document development of marine mudbanks, progradation or colonization by mangroves, and supratidal sedimentation. Evidence suggests erosion of mangroves by storms is a common precursor to subsequent sediment aggradation on both islands. Results indicate nucleation from a supratidal precursor and mangrove colonization of marine mudbanks are both viable mechanisms for island initiation. Data from Florida Bay are insufficient to discriminate between the relative importance of these two models of island evolution.

Study Type:Qualitative; Habitat:Mud; Number of Stations:17; Abiotic Parameters Measured:Sediment characteristics; Gear Type:Cores.

311. Quinn, T. M. and D. F. Merriam. 1985. Florida Bay revisited; development of a shallow-water carbonate facies mosaic in response to the Holocene transgression. Geol. Soc. Am., Abstr. Progr. 17(7):69.

A complex shallow-water carbonate facies mosaic has developed in Florida Bay (ENP) in response to the Holocene transgression. It is found in the sedimentary record of Florida Bay islands and consists in, upward succession of 1) a freshwater mud facies; 2) a transgressive basal peat facies; 3) a skeletal packstone and wackestone facies; 4) an organic-rich skeletal wackestone facies; 5) an upper peat facies; and, 6) a supratidal mudstone facies. Detailed sedimentary analysis revealed that some facies are absent from many islands. The authors believe that most islands initiate and nucleate from coastal supratidal flats. A C 14 database for south Florida peats was created, indicating that a rise in sea level at 1.9 mm/year has occurred from 5400 to 3000 yr B.P., more recently south Florida has been inundated at a rate of 0.3 mm/yr.-Adapted from authors' abstract.

312. Raymond, R. J. and T. D. Davies. 1979. Content and form of sulfur in coal: A reflection of peat depositional environments. Geol. Soc. Am., Abstr. Prog. 11(7):501.

Chemical, optical, and electron microprobe techniques were used to study content and form of sulfur in peat from Florida Bay (ENP) and from western Pennsylvania. The results reveal three periods of sulfur emplacement in the peat/coal cycle. The first period reflects the peat depositional environment. If deposition occurs in freshwater, organic sulfur will be low and pyrite may be absent; in marine water, the peat will have high organic sulfur and may have high pyrite. The second period occurs after peat deposition, but prior to coalification; pyrite and sulfur will increase if marine waters were present. Sulfur emplacement is greater in freshwater peat if it is overlain by marine peat. During the third period, after coalification, the sulfur content is not altered.-Adapted from authors' abstract.

313. Raymond, R. J. and T. D. Davies. 1981. Mangrove (*Rhizophora mangle*) root intrusion, a means for enriching sulfur in underlying peats. Scanning Electron Microsc. 1(651-656).

Electron probe microanalysis (EPM) has shown that Lower Kittanning coal samples (a seam in Western Pennsylvania) with freshwater overburden contain the least organic S, while those with marine overburden contain the most organic S. The organic S contents of freshwater coals are greater than those of marine coals conformably overlying them. Chemical analyses performed on Florida Bay (ENP) peats deposited in freshwater environments and later affected by marine waters permeate a previously deposited low S peat, the organic S content will be increased. A mechanism must be present that increases permeability of the underlying peats and provides avenues along which marine waters travel downward. From scanning electron microscopy and petrographic data root

intrusion by *R. mangle L.* (red mangrove) trees that grow in a marine environment appear to be a mechanism for emplacement of fin-grained pyrite in underlying freshwater peats. Root intrusion may provide a means for enriching organic S in freshwater peats overlain by marine conditions.-Author's abstract.

314. Rehm, A. E. 1976. The effects of the wood-boring isopod, *Sphaeroma terebrans*, on the mangrove communities of Florida. Environ. Conserv. 3(1):47-57.

To determine the effects of the wood-boring isopod, *Sphaeroma terebrans* on the mangrove communities of Florida, two principal sites were selected; one along the shoreline of Tampa Bay and the other on the causeway that connects Everglades City to Chokoloskee on the extreme western border of ENP. A detailed description of each habitat was given including mangrove communities along with tides, salinity, air & water temperature ranges. Life history aspects and the distribution of *S. terebrans* in Florida was presented. It was found that for *Sphaeroma* to successfully borrow in mangrove roots, water levels at high tide must be 12 inches (active zone) and that mangroves that become established in the active zone do not persist. However, barnacles or oysters can act as a protective covering, preventing isopods from burrowing in red mangrove seedlings. Black and white mangroves are usually found in areas above the active zone, and may not be as impacted as red mangroves. Exceptions to this rule were found in Tampa Bay and were described. The extent to which *S. terebrans* destroys mangroves in relation to tides, temperatures, and salinity was examined. The author suggests that in Whitewater Bay the destruction of mangrove islands may be, in part, the result of *S. terebrans* activity, as it is common there. The impact of this isopod on estuarine dependent, mangrove associated, commercial fisheries was also discussed.

Study Period:Variable/up to 1 year for environmental factors; Study Type:Qualitative; Habitat:Coastal mangrove; Number of Stations:2; Biological Component:Mangroves, isopod; Abiotic Parameters Measured:Salinity, air & water temp., tide level; Dominant Taxon/Taxa Studied; Red mangrove *Rhizophora mangle*, isopod, *S. terebrans*.

315. Rehm, A. E. 1974. A study of the marine algae epiphytic on the prop roots of *Rhizophora mangle* from Tampa to Key Largo, Florida. Ph.D. Dissertation, Univ. of South Florida, Tampa. 183 pp.

In this qualitative study of the distribution and ecology of marine algae epiphytic on the prop roots of the red mangrove, *Rhizophora mangle*, from Tampa to Key Largo, Florida, the following areas within and or adjacent to the park boundary were investigated: Everglades City to Cape Sable area, and Key Largo including Lake Surprise and mangrove channels near El Radabob Key. Until this work was completed, little was known about the algae colonizing the prop roots of red mangroves in Florida. Upon initiation of the field work, it was discovered that a boring isopod, *Sphaeroma terebrans*, was destroying the prop roots of red mangroves primarily from Cape Sable northward along the Gulf coast. (Rehm and Humm 1973, no. 316 in bibliography, Appendix J.). It was found that the red mangrove fringe is confined by *Sphaeroma* to a higher level of the intertidal zone that it would otherwise occupy. Around Key Largo, where *Sphaeroma* is not attacking mangroves, the trees are lower in the intertidal zone and the algal epiphytes are of greater variety and abundance. Four major factors were identified

in determining the variety and abundance of algae on the roots: 1) ratio of diurnal and semidiurnal tides in an area; 2) the salinity regime; 3) light penetration through the mangrove stand; 4) substrate beneath the mangrove stand. A total of 74 species of marine algae were recorded as prop root epiphytes. Data were also presented on zonation profiles and on the resistance of prop root epiphytes to desiccation and salinity.

Study Period:1971-1972; Study Type:Qualitative; Gear Type:Hand; Number of Stations:13 (2 in Key Largo, 3 from Cape Sable to Everglades City); Number of Replicates/Station:25-148 roots per site; Temporal Frequency:Irregular; Habitat:Prop roots; Abiotic Parameters Measured:Salinity, water temperature, tides, substrate, light intensity; Dominant Taxon/Taxa Studied:Rhodophyta (*Bostrychia, Caloglossa, Catenella, Murrayella*).

316. Rehm, A. E. and H. J. Humm. 1973. *Sphaeroma terebrans*: A threat to the mangroves of southwestern Florida. Sci. 182(4108):173-174.

*Sphaeroma terebrans*, a wood boring isopod, is destroying the prop roots of red mangroves, *Rhizophora mangle*, along the southwestern coast of Florida, mostly within the boundaries of ENP, to such an extent that the Ten Thousand Islands and mangrove fringes of the mainland are steadily sinking. Mangroves of the Florida Keys from Key Largo to Key West are apparently free of this wood borer.

Study Type:Qualitative; Habitat:Coastal mangrove; Biological Component:Isopod, red mangrove; Dominant Taxon/Taxa Studied:*Sphaeroma terebrans, Rhizophora mangle.*

317. Rich, F. J., D. Kuehn and T. D. Davies. 1982. The paleo-ecological significance of ovoidites. Palynology 6:19-28.

Ovoidites is an ovoid zygospore or aplanospore of the Zyngnemataceae which is found in sediments of Cretaceous to Holocene age. Spores typically exhibit a prominent line of dehiscence that allows them to split in half lengthwise. The variety of sizes, shapes and sculpturing suggests that several natural species may be included within Ovoidites. Studies of sediment cores from marine, brackish, and freshwater sequences beneath islands in Florida Bay and at the mouth of the Harney River (in ENP) demonstrate the close association which the spores have with the freshwater peats and related pollen assemblages. The spores typically are not found in tree- or shrub-dominated areas and are not associated with tree and shrub peats. The apparently narrow range of habitat preferences which the algae display suggest that Ovoidites may be a valuable indicator of ancient freshwater coal deposits.-Adapted from an abstract obtained from D. Deis, CSA.

318. Riegel, W. L. 1965. Palynology of environments of peat formation in southwestern Florida. Ph.D. Dissertation, The Pennsylvania State Univ., University Park, Pa. 189 pp.

One hundred and two surface samples from nine different environments and 58 subsurface samples from four cores have been collected mostly within the open marsh, mangrove, and Shark River areas of ENP, and prepared for palynological

analysis. Pollen and spores samples were used to show distribution within cores and at the surface and were then evaluated with respect to the ecological and geological setting of the area. Results indicated that most pollen types in southwestern Florida exhibit a restricted distribution and are used in the formation of pollen zones which may vary with changes in hydrologic conditions. Changes in pollen assemblages appear to be transitional along river courses while those from inland bays do not represent local vegetation, but are mostly derived from the reworking of older sediments. The need for reevaluation of pollen analysis based on evidence from temperate/tropical areas was discussed. The relative rise in sea level in this region was substantiated in relation to changes in plant communities. The sedimentary up-building in the mangrove environment appears to delay the transgression of the sea.

Study Type:Qualitative; Habitat:Bays, rivers, coastal mangroves, hammocks; Number of Stations:Variable; Gear Types:Cores (Hiller Borer); Biological Component:Flora; Dominant Taxon/Taxa Studied:*Avicennia*.

319. Robblee, M. B. and J. T. Tilmant. 1989. Distribution, abundance, and recruitment of the pink shrimp (*Penaeus duorarum*) within Florida Bay. Bull. Mar. Sci. (Abstract). 44:522.

The Tortugas shrimping grounds were first exploited commercially in 1950 prompting intensive study of the early life history of the pink shrimp, *Penaeus duorarum*, in the shallow nearshore waters of the southern tip of Florida. This work established Florida Bay (ENP) as the primary nursery ground for pink shrimp. Within the Bay, the pink shrimp is important as food for gamefish species and wading birds. We used the sled net and the throw trap, a quantitative sampling device, to describe the seasonal and spatial character of pink shrimp distribution in Florida Bay from Oct. 1981 to Oct. 1986. Most of the seasonal observations and recruitment studies were in Johnson Key Basin, a high density shrimp area in western Florida Bay. The pink shrimp was present throughout the year in Johnson Key Basin and was most abundant during fall and winter with peak abundance between September and December. Average shrimp size varied seasonally, but was higher in 1986 than in 1985. During fall and winter, shrimp were most abundant in near-key habitats in Johnson Key Basin when compared to bank and basin. Very small shrimp were most abundant in near-key habitats, however its distribution by size was similar among habitats. Based on sampling in January 1986, shrimp generally were most abundant in the west when compared with central and eastern Florida Bay. Over the whole Bay, where shrimp are present, they appear to be most abundant in shallow water, either near-key or bank habitat.-Adapted from authors' abstract.

320. Robblee, M. B., J. T. Tilmant and J. Emerson. 1989. Quantitative observations on salinity. Bull. Mar. Sci. (Abstract). 44:523.

Observation records from 29 published and unpublished studies dating from 1936 were used to characterize salinity conditions and determine long-term temporal and spatial changes that may occur in Florida Bay (ENP). A total of 6,231 records were available for this analysis. During all but unusually high rainfall years, evaporation exceeds upland runoff into Florida Bay and hypersaline conditions (>35 ppt) prevail throughout much of the main body of the Bay. The highest

salinity conditions consistently occur within the central basins while the lowest occur in the upper northeast reaches of the Bay. An increasing salinity gradient has consistently occurred from the upper Nest Key basin eastward into Blackwater Sound suggesting the major region of upland runoff lies between Little Madeira and Joe Bays. Seasonal dynamics of salinity conditions within the Bay are tied to seasonal rainfall patterns. Consistent temporal data upon which to evaluate long-term changes in environmental conditions at any given location are limited. However, observable trends within the database will be present.-Adapted from authors' abstract.

321. Roberts, A. A., J. G. Palacas and I. C. Frost. 1973. Determination of organic carbon in modern carbonate sediments. J. Sed. Petrol. 43(4):1157-1159.

In the routine analysis for organic carbon in modern unconsolidated sediments the initial step commonly is to remove the carbonate carbon by acid treatment and to analyze directly the organic carbon in the residue. As much as 44% of the organic carbon in modern carbonate sediments from Florida Bay (ENP) is solubilized and lost during the acid treatment. Therefore, the amount of carbon in these ,and in similar modern sediments, must also be included in the analysis for an accurate determination of the percentage of total organic carbon in the sample.

Study Type:Quantitative: Habitat:Bottom sediments; Number of Stations:8.

322. Roberts, H. H., L. J., Jr. Rouse, N. D. Walker and J. H. Hudson. 1982. Cold water stress in Florida Bay and northern Bahamas: A product of winter cold-air outbreaks. J. Sediment. Petrol. 52(1):145-155.

*In situ* water temperatures, meteorological data, and thermal infrared data from the NOAA-5 meteorological satellite were used to study the thermal evolution of Florida Bay (ENP) and Bahamas Bank waters during January 1977 when 3 consecutive cold fronts crossed south Florida and the northern Bahamas, reducing water temperatures below the lethal limit for most reef corals. Florida Bay water was depressed below 16°C, a thermal stress threshold for most reef corals, for 8 days. Minimum *in situ* temperature recorded was 12.6°C. Bathymetry controlled routes of cold water masses are described and their effect noted. Coral and fish kills were reported along the Florida Reef Tract and northern Bahamas, with up to 91% coral mortality at Dry Tortugas. This provide evidence that cold water stress conditions can exist over vast shallow water areas for periods of days, resulting in restriction of reef community development throughout the study area.

Study Period:January 1977; Habitat:Coral reef, water column; Study Type:Quantitative; Gear Type:Satellite imagery/field observations; BiologicaL Component:Corals (Cnidaria); Abiotic Parameters Measured:Water & air temperature, wind velocity; Dominant Taxon/Taxa Studied:*Montastrea annularis*, *Acropora cervicornis*, *Porities porities*.

323. Roberts, H. H., L. J.,Jr. Rouse and N. D. Walker. 1983. Evolution of cold water stress conditions in high latitude reef systems, Florida (USA) reef tract and the Bahama Banks (West Indies). Caribb. J. Sci. 19(1-2):55-60.

Thermal depression of shallow bank and bay waters accompanying the passage of severe cold fronts can stress high latitude coral reef systems, such as those of the Florida Reef Tract and northern Bahama Banks. Laboratory and field experiments suggest that sustained temperatures below 16°C are detrimental to most reef-building corals. During a series of three cold-air outbreaks (Jan. 1977) Florida Bay (ENP)waters reached a temperature minimum of 12.9°C and remained under the 16°C lethal limit for eight days. At Dry Tortugas 91% of the *Acropora cervicornis* community was reported killed. These studies indicate that the temperature of subtropical bank and bay waters is subject to depression below 16°C accompanying the outbreak of unusually cold air.

Study Period:January 1977; Study Type:Qualitative; Gear Type:Satellite and field observations; Number of Stations:2 (Water temperature sites in Florida Bay area), 1 (Air temp. & wind speed in Miami); Habitat:Open water; Biological Component:Coral; Abiotic Parameters Measured:Water & air temp., wind speed; Dominant Taxon/Taxa Studied:*Acropora cervicornis*.

324. Roberts, H. H., T. Whelan and W. G. Smith. 1977. Holocene sedimentation at Cape Sable Florida. Sediment. Geol. 18:25-60.

A variety of sedimentary environments were investigated at Cape Sable to determine the depositional history and compare seven types of environments including shell beaches and beach ridges, black mangrove mudflats, ponded mudflats, exposed mudflats, Lake Ingrahm, coastal levees and supratidal plain, and ephemeral ponds. Dominant sediments were calcareous muds and silts. Formation of the capes show three different dates based on radiocarbon dating. Cores reveal a carbonate-mud sequence similar to present subtidal sediments. A typical marine carbonate-mineral suite, with numerous mollusks and *Thalassia* roots, was found. Results of analysis indicate that diagenesis of organic matter and an increase in chlorinity has occurred from the youngest to the oldest levee.

Study Type:Qualitative; Gear Types:Short cores, surface samples, piston-coring apparatus; Abiotic Parameters Measured:Sediment characteristics, mineralogy.

325. Robins, C. R. and D. C. Tabb. 1965. Biological and taxonomic notes on the blue croaker, *Bairdiella batabana*. Bull. Mar. Sci. 15:495-511.

Collections from Sandy Key Basin, western Florida Bay (ENP), resulted in the redescription of the little known blue croaker, *Bairdiella batabana*. The nomenclatural history and bibliographic synonymy of *B. batabana* is discussed. Analysis of meristic and morphological characters indicate that this species is very near *B. chrysoura*. Both species have been collected together in south Florida in mixed seagrass beds of *Thalassia-Syringodium-Halodule*. *B. batabana* feed on small crustaceans; larger specimens move to deeper water, its distribution is spotty due to its special habitat preferences. The authors suggest it may have a wide-spread distribution along the Atlantic coast of Central America.

Study Period:1958-1964; Study Type:Qualitative; Habitat:Mixed seagrass beds (juveniles), coral,rock (adults); Biological Component;Water column fish; Abiotic Parameters Measured:Salinity, temperature, depth; Dominant Taxon/Taxa Studied:*Bairdiella batabana*.

326. Roessler, M. A. 1970. Checklist of fishes in Buttonwood Canal, Everglades National Park, Florida, and observations on the seasonal occurrence and life histories of selected species. Bull. Mar. Sci. (20):860-893.

Between January 1963 and June 1965, 103 species of fishes, representing 83 genera and 49 families were collected in Buttonwood Canal (ENP). For most species, data is presented on seasonal occurrence, relative abundance, and the ranges for salinity and temperature at times when fishes were collected. Length frequency data are given for *Elops saurus*, *Harangula pensacolae* (now *jaguna*), *Anchoa hepsetus*, *Diapterus plumieri*, *Bairdiella chrysura* (now *chrysoura*), and *Sciaenops ocellata*. The catches of *Brevoortia smithi*, *H. jaguna*, *Opisthonema oglinum*, *A. hepsetus*, *Eucinostomus gula*, *Lagodon rhomboides*, *B. chrysoura*, and *Achirus lineatus*, were associated with environmental factors. Season and rainfall were the most significant parameters related to the catches of these fishes.

Study Period:January 1963-June 1965; Study Type:Qualitative, quantitative; Habitat:Water column; Gear Type:Channel net; Temporal Frequency:Semimonthly; Number of Stations:1; Biological Component:Fishes; Abiotic Parameters Measured:Salinity, air and water temperature, current velocity, depth, cloud cover, wind direction and velocity, tidal height;current velocity; Dominant Taxon/Taxa Studied:*Harangula jaguna*, *Opisthonema oglinum*, *Brevoortia smithi*, *Lagodon rhomboides*, *Bairdiella chrysoura*.

327. Roessler, M. A. 1967. Observations on the seasonal occurrence and life histories of fishes in Buttonwood Canal, Everglades National Park, Florida. Ph.D. Dissertation. Univ. of Miami, Coral Gables. 155 pp.

Semi-monthly collections of fishes from the Buttonwood Canal between January 1963 and June 1965 produced 103 species, representing 83 genera and 49 families; these fish were taken as part of a project to study juvenile pink shrimp, *Penaeus duorarum*. Their seasonal occurrence and relative abundance was reported as well as their salinity and temperature ranges; 70 species occurred in water of higher salinities than previously reported. For 17 species, length-frequency data were presented, and growth and spawning season discussed. For eight species, *Brevoortia smithi*, *Harangula pensacolae* (now *jaguna*), *Opisthonema oglinum*, *Anchoa hepsetus*, *Eucinostomus gula*, *Lagodon rhomboides*, *Bairdiella chrysura* (now *chrysoura*), and *Achirus lineatus*, the catches were associated with environmental parameters. *Brevoortia* and *Bairdiella* were most frequently caught in the spring and fall, *Lagodon* in the winter and spring, and *Harangula*, *Opisthonema*, *Anchoa*, and *Eucinostomus* were most abundant in summer. Season and rainfall were the most significant parameters related to the catches of these fishes. In addition, gray snapper sportfishermen catches at Flamingo were positively correlated with the abundance of the above fishes from the Buttonwood Canal. These fishes form an important part of the gray snapper food web. Catches of other sport fish were not correlated with catches of these forage fishes.

Study Period:January 1963-June 1965; Study Type:Quantitative; Habitat:Canal (water column); Number of Stations:1; Temporal Frequency:Semi-monthly; Number of Replicates/Station:Two consecutive nights; Gear Type:Channel net; Biological Component:Fishes; Abiotic Parameters Measured:Salinity, air & water temperature,

current velocity, tide level, cloud cover, wind direction; Dominant Taxon/Taxa Studied:*B. smithi, B. chrysoura, L. rhomboides, H. jaguna, O. oglinium, A. hepsetus, E. gula.*

328. Roessler, M. A., A. C. Jones and S. L. Monro. 1969. Larval and postlarval pink shrimp, *Penaeus duorarum*, in south Florida. Pgs, 859-866. IN: M.A. Mistakidis, ed. Proceedings World Sci. Conf. Biol. Cult. Shrimps and Prawns, FAO Rept. No. 57. Vol 3. Rome.

Narrative same as in reference no. 329.

329. Roessler, M. A. and R. G. Rehrer. 1971. Relation of catches of postlarval pink shrimp in Everglades National Park, Florida, to the commercial catches on the Tortugas grounds. Bull. Mar Sci. 21:790-805.

Postlarval pink shrimp were sampled at Buttonwood Canal and Little Shark River (ENP), from July 1965 to December 1967. Environmental effects on postlarval catches were observed and the catches of immigrating *Penaeus* were compared with commercial catches of *Penaeus* on the Tortugas Grounds. Postlarvae were more abundant at night, during flood tides, in bottom samples, during new and first quarter lunar periods and during the summer. An index of abundance was selected at both stations with which it was possible to predict 61% of the monthly variation in commercial Tortugas catches.

Study Period:July 1965-December 1967; Study Type:Quantitative; Habitat:Water Column; Gear Type:Plankton net (471 mesh); Number of Stations:2; Temporal Frequency:Diel, lunar; Biological Component:Decapod crustacea; Abiotic Parameters Measured:Salinity, temperature, current velocity; Dominant Taxon/Taxa Studied:*Penaeus duorarum.*

330. Rosenfeld, J. K. 1979. Amino acid diagenesis and adsorption in nearshore anoxic sediments. Limnol. Ocennogr. 24(6):1014-1021.

Nearshore anoxic sediments were sampled with cores in eastern Florida Bay (ENP), Long Island Sound (New York), and Pettaquamscutt River (Rhode Island) to examine amino acid diagenesis and free amino acid adsorption by sediments. At one meter sediment depth, organic nitrogen and amino acid content were half that of surface values. Both elasyic and carbonate sediments utilized equal amounts of acidic and neutral amino acids, in opposition to the preferential utilization of certain amino acids in deep sea sediments. Laboratory adsorption experiments were used to explain preferential utilization of free amino acids in clay and carbonate sediments.

Study Type:Quantitative; Gear Type:Corer; Habitat:Mud, sand; Number of Stations:6 (2 in Florida Bay); Abiotic Parameters Measured:Organic nitrogen, amino acids, organic carbon, ammonium.

331. Rosenfeld, J. K. 1979. Ammonium adsorption in nearshore anoxic sediments. Limnol. Oceanogr. 24(2):356-364.

The distributions of dissolved, exchangeable and fixed ammonium were measured in sediment cores from Long Island Sound (New York), eastern Florida Bay (ENP), and Pettaquamscutt River, Rhode Island and in laboratory experiments to determine the importance of ammonium adsorption in anoxic sediments. The exchangeable ammonium concentration increased linearly with increasing concentrations of dissolved ammonium; exchangeable ammonium adsorption was rapid, reversible and predominantly associated with the organic matter rather than the clay minerals.

Study Type:Quantitative; Gear Type:Corer; Habitat:Mud, sand; Number of Stations:6 (2 in Florida Bay); Abiotic Parameters Measured:Exchangeable and dissolved ammonium.

332. Rosenfeld, J. K. 1979. Interstitial water and sediment chemistry of two cores from Florida Bay. J. Sed. Petrol. 49(3):989-994.

Mangrove swamp and submerged mud bank cores from Florida Bay (ENP) were analyzed for differences in interstitial water and sediment chemistry characteristics. Sulfate reduction was observed in the samples. The sulfate concentration profile is atypical of other anoxic environments because sulfate concentrations increase below 20 cm, possibly as a result of a balance between the mixing of the interstitial water with overlaying seawater. Also, organic decomposition rates decrease with depth. Profiles of other chemical factors are discussed.

Study Type:Qualitative; Gear Type:Cores; Number of Stations:2; Abiotic Parameters Measured:Ammonium phosphate, alkalinity, sulfate reduction, organic carbon, organic nitrogen, amino acid.

333. Rosenfeld, J. K. 1977. Nitrogen diagensis in nearshore anoxic sediments. Ph.D. Dissertation, Yale Univ., New Haven, Conn. 200 pp.

No abstract available. A copy of this dissertation is on file at Yale Univ., New Haven, CT.

334. Rosenfeld, J. K. and R. A. Berner. 1976. Ammonia adsorption in nearshore anoxic sediments. Geol. Soc. Am., Abstr. Prog. 8(6):1076.

Narrative same as in reference no. 331.

335. Rouse, W. 1970. Littoral crustacea from southwest Florida. Quart. Jour. Fla. Aca. Sci. 32(2):127-152.

An annotated checklist of decapods, stomatopods, and isopods is presented based on studies from the estuarine and coastal marine waters of ENP.

Study Type:Quantitative, qualitative; Gear Type:Trawl, dredge, grab, nets, traps; Number of Stations:21; Biological Component:Crustacea; Abiotic Parameters Measured:Salinity, temperature, depth, bottom types; Dominant Taxon/Taxa Studied:*Paracerceis caudata, Neopanope packardii.*

336. Russel, R. J. 1971. Beaches and ground water of Cape Sable, Florida, during extreme drought. Coas. Stud. Insti. Louis. St. Univ. Tech. Rept. No 103. 18 p.

Cape Sable beaches and water tables were investigated in October 1969, after 5 months of adequate rainfall. In April, after 5 months of drought, a similar study was made. Cape Sable (ENP) is isolated from mainland surface runoff by extensive areas of lakes and waterways with marine salinities, and from subsurface flow of groundwater by a thick section of compact marl and compressed peat. Accumulation of groundwater depends on local rainfall, and its volume varies with size and permeability of catchment areas. The conclusions of this study are applicable to many other coastal areas and may be useful in assessing their population and survival potentialities.-Adapted from an abstract obtained from a report on the geology of ENP. (See reference no. 519.)

337. Rutherford, E. S. 1982. Age, growth, and mortality of spotted seatrout, *Cynoscion nebulous*, in Everglades National Park, Florida. M.S. Thesis, Univ. Miami, Coral Gables. 65 pp.

This study examined the age, growth and mortality of 570 spotted seatrout taken from sportfishermen catches in ENP from November 1978 to January 1980. Fish ranged in length from 220-680 mm and in weight from 0.1 - 2.24 kg. Ages of the catch were mainly 3 and 4 year olds. Males lived to at least 6 years, females to 7 years. Fish length varied between sexes and among areas of capture. Calculated fish length (from scale annuli) and length at capture were largest in brackish area and smallest in a hypersaline area of the park. Annual mortality rate of all fish was 77%. Yield per recruit of all fish was at maximum for the given 12 inch minimum size limit. Age distribution, age at full recruitment, and mortality have changed since an earlier study in 1959; dominant ages shifted from 2-3 year old fish to 3-4 year olds, age at full recruitment shifted from age 3 to age 4, while annual mortality of all fish increased since 1959.

Study Period:November 1978-January 1980; Study Type:Qualitative, quantitative; Habitat:Estuarine/coastal marine; Gear Type:Dockside interviews from H & L catches; Biological Component:Sportfish; Dominant Taxon/Taxa Studied:*Cynoscion nebulous.*

338. Rutherford, E. S., T. W. Schmidt and J. T. Tilmant. 1986. Early life history of spotted seatrout, red drum, gray snapper, and snook in Everglades National Park, Florida. Rept. 86/07. Homestead, FLa., Everglades N.P., South Florida Research Center. 99 pp.

This report presents information on distribution, habitat, and relative abundance of larvae and juveniles of the four most popular gamefish species in ENP, (spotted seatrout, red drum, gray snapper, snook). Larvae were sampled from 1982 to 1985 in passes and creeks bordering the park and sampled juveniles from 1973

to 1976 and from 1982 to 1985 in mangrove creeks, channels, shorelines, banks, basins, and bays. Larvae of spotted seatrout and red drum and juveniles of all species were collected. Seatrout spawned in park waters; peak catches of larvae occurred from June to September. Catches varied by station and year but approximated those taken 20 years ago. Juveniles were most abundant in western Florida Bay mixed seagrass beds. Red drum entered the park from September to January as larvae and inhabitated brackish waters near mangrove shorelines and in creeks. Larval red drum catches were lower than those taken 20 years ago. Gray snapper entered park waters as post larvae and small juveniles, inhabitating seagrass beds in banks, basins and channels; Juvenile snook were present in mangrove shorelines and creeks.

Study Period:1973-1976, 1982-1985; Study Type:Qualitative, quantitative; Habitat:Passes, mangrove creeks, channels, shorelines, banks, basins, bays; Number of Stations:27 (1973-1976); Number of Replicates/Station:1-5; Gear Type:Trawls, seines, nets, rotenone, explosives; Abiotic Parameters Measured:Salinity, temperature, depth; Dominant Taxon/Taxa Studied:Spotted seatrout, gray snapper, red drum, snook.

339. Rutherford, E. S., T. W. Schmidt and J. T. Tilmant. 1989. Early life history of spotted seatrout, *Cynoscion nebulous*, and gray snapper, *Lutjanus griseus*, in Florida Bay. Bull. Mar. Sci. 44:49-64.

Information on distribution, habitat, and relative abundance of spotted seatrout and gray snapper in Florida Bay ENP is presented. Larvae were sampled from 1982 to 1984 in channels, passes, and creeks bordering Florida Bay and juveniles were sampled from 1973 to 1976 and from 1982 to 1985 in mangrove creeks, channels, shorelines, banks, basins, and bays. Spotted seatrout were found to spawn predominantly in western Florida Bay. Spotted seatrout larvae were caught in marine salinities with peaks in June to September. Juveniles were collected mainly in mixed species of seagrass beds and were most abundant in mixed seagrass beds of western Florida Bay. Gray snapper spawn outside of park waters. They enter Florida Bay as post larvae and small juveniles, inhabitating seagrass beds in banks, basins, and channels, and mangrove prop roots. Juveniles were most abundant in mixed seagrass beds than other areas sampled. Monthly mortality rates of juvenile seatrout (A = 34.7%) and juvenile snapper (A = 39.5%) were estimated using catch curve analysis of length frequencies.

Study Period:1973-1976, 1982-1985; Study Type:Qualitative, quantitative; Habitat:Mangrove creeks, channels, shorelines, basins, banks, bays; Number of Stations:27 (1973-76), irregular (1982-85); Number of Replicates/Stations:1-5; Gear Types:Trawls, seines, nets, rotenone; Temporal Frequency:Monthly-irregular; Biological Component:Sportfish; Abiotic Parameters Measured:Salinity, temperature, depth; Dominant Taxon/Taxa Studied:*Cynoscion nebulous*, *Lutjanus griseus*.

340. Rutherford, E. S., E. B. Thue and D. G. Buker. 1982. Population characteristics, food habits, and spawning activity of spotted seatrout, *Cynoscion nebulous*, in Everglades National Park, Florida. Rept. T-668. Homestead, Fla., Everglades N.P., South Florida Research Center. 48 pp.

From November 1978 to January 1980, age, growth, mortality, foods, and spawning activity of 570 spotted seatrout were studied from sportfishermen catches in ENP. Results indicated that ages of fish were mainly 3-5 year olds, fish were fully recruited by age 4, males and females lived to ages 6 and 7, respectively, while the sex ratio favored females. Fish lengths, back calculated from scale annuli, varied between sexes, among seasons of capture, and year classes. Annual mortality of all fish was 0.77. Their diet was carnivorous, consuming shrimp and fish; it varied with size. Spotted seatrout spawned year-round with peaks in spring and summer; fish aged 2-4 contributed most to the spawn. When results of this study were compared with an earlier investigation (Stewart 1961, no. 397 in bibliography), apparent changes in age distribution, age at full recruitment and mortality since 1959 were found, although mean sizes at age of fish have not changed.

Study Period:November 1978-January 1980; Study Type:Qualitative, quantitative; Gear Type:Hook & line; Habitat:estuarine and coastal marine; Dominant Taxon/Taxa Studied:*Cynoscion nebulous*.

341. Rutherford, E. S., E. B. Thue and D. G. Buker. 1983. Population structure, food habits, and spawning activity of gray snapper, *Lutjanus griseus*, in Everglades National Park. SFRC-83/02. Homestead, Fla., Everglades N.P., South Florida Research Center. 41 pp.

Population structure, food habits, and spawning activity of 1026 gray snapper, *Lutjanus griseus*, were studied from sportfishermen catches in ENP from November 1978 through January 1980. Results showed that fish age ranged from 1-7 years, 2-3 year old fish dominated the catch, and recruitment was complete by age 3. Fish taken from Cape Sable were older than fish taken from other areas. Growth varied between sexes and among areas of capture; females were larger than males at ages 1-2. Fish taken from hypersaline areas were larger than fish taken from brackish waters. Annual survival rate of fully recruited fishes was s = 0.28; male survival was higher than that for females. Gray snapper apparently spawn outside of park waters. Their diet, consisting mainly of fish, shrimp, and crabs, varied with age, among seasons, and areas of capture. Comparison of this study with an earlier study of park gray snapper (Croker 1960, no. 63 in bibliography) showed increases in survival and longevity since 1960.

Study Period:November 1978-January 1980; Study Type:Qualitative, quantitative; Gear Type:Hook & line; Habitat:Estuarine and coastal marine; Dominant Taxon/Taxa Studied;*Lutjanus griseus*.

342. Rutherford, E. S., J. T. Tilmant, E. B. Thue and T. W. Schmidt. 1989. Fishery Harvest & population dynamics of spotted seatrout, *Cynoscion nebulous*, in Florida Bay and adjacent waters. Bull. Mar. Sci. 44:108-125.

Catch rates of spotted seatrout, one of the most popular recreational gamefish in ENP, have been monitored since 1958; total harvest and effort data and commercial landings have been monitored since 1973, and lengths have been measured since 1974. Sport fisherman catch rates of Florida Bay spotted seatrout were higher from 1958 to 1967 than from 1973 to 1985 and reached a record low in 1973-1977. Total harvest increased in 1979 because of increased commercial

harvest, and declined again in 1980 when bag limits reduced commercial and recreational catches. Total annual effort was closely correlated with harvest. Results suggest different unit stocks in the Florida Bay area and the Gulf coast area of the park. The reduction in harvest was due to reduction in fishing effort and environmental factors. Current harvest levels have moderate impact on the stock. Age of harvested seatrout ranged from age 1-8 with ages 3-5 providing up to 70% of the catch. Estimated population size ranged from 686,000 to 786,00 fish from 1974 to 1978 and decreased to 631,000 fish by 1984. Catch rates were poorly correlated with rainfall and water levels in upland marshes.

Study Period:1958-1985; Study Type:Quantitative; Gear Type:Dockside interviews, field observations; Biological Component:Sportfish; Dominant Taxon/Taxa Studied:*Cynoscion nebulous*.

343. Rutherford, E. S., J. T. Tilmant, E. B. Thue and T. W. Schmidt. 1989. Fishery harvest and population dynamics of gray snapper, *Lutjanus griseus*, in Florida Bay and adjacent waters. Bull. Mar Sci. 44:139-154.

Catches of gray snapper, an important recreational gamefish species in south Florida, have been monitored since 1958 in ENP; total harvest and effort data have been collected since 1973, and lengths have been measured since 1974. Peak catches occurred in 1959, 1964-1966, and 1977-1979. Sportfishermen account for most of the total harvest (78%), followed by guided parties (21%), and commercial fisherman (1%). Harvest decreased between 1973-1976, increased during the mid-1970's, but declined again during the 1980's. It is believed that reduced catches were due to increased effort for other species as well as reduced stock abundance and recruitment. Snapper are recruited to the park fishery at age-1; 3-4 year old fish make up 87% of the catch. They spawn outside of park waters. Population size and recruitment are not controlled by fishing effort within the park, however environmental factors and effort in the Florida Keys may control stock size.

Study Period:1958-1985; Study Type:Qualitative, quantitative; Gear Type:Dockside interviews, field observations; Biological Component:Sportfish; Dominant Taxon/Taxa Studied:*Lutjanus griesus*.

344. Ryan, J. D., F. G., III Lewis and S. J. Schropp. 1989. Metal and nutrient concentration in Florida Bay sediments. Bull. Mar. Sci. (Abstract). 44:523.

Geochemical conditions of bays and estuaries can be easily determined by analyzing bottom sediments, which comprise a reservoir reflecting present, as well as historic inputs to these coastal environments. For naturally occurring substances (e.g., metals and nutrients), however, an interpretive problem arises in distinguishing an anthropogenic contribution to the natural faction. Using two interpretive tools recently developed for coastal Florida, metal (cadmium, chromium, copper, mercury, nickel, manganese, and zinc) and nutrient (total organic carbon, total Kjeldahl nitrogen, and total phosphorous) concentrations were assessed for sediments from a variety of Florida Bay (ENP) habitats (i.e., seagrass beds, mangroves, and soft-bottom unvegetated areas). Nutrient data were collected seasonally, while metals information was collected only once. Results were compared with data from other "pristine" coastal environments of south

Florida in an attempt to establish background ranges of these constituents for the lower peninsula of the State. Metal and nutrient levels in Florida Bay were very low and typical of those reported for clean carbonate sediments.-Adapted from authors' abstract.

345. Sastrakusumah, S. 1971. A study of the food of juvenile migrating pink shrimp, *Penaeus duorarum* Burkenroad. M.S. Thesis, Univ. of Miami, Miami, Fla. 37 pp.

Also publ. as: Sea Grant Tech. Bull. No. 9, Univ of Miami Sea Grant Prog., Miami, Fl. 1-37 p. (1971).

Qualitative information on the foods of juvenile pink shrimp in the Buttonwood Canal (ENP) was gathered over a year's period. Using the frequency of occurrence method of analysis, it was found that the pink shrimp in the Buttonwood Canal is omnivorous with a preference for certain foods, including crustaceans and polychaetes. Lowest feeding activity was reported in late winter and in summer. It was concluded that there was no change in diet with season or with size of shrimp examined.

Study Period:January-December 1963; Study Type:Qualitative; Biological Component:Decapod crustacea; Gear Type:Channel/wing net; Number of Stations:1; Number of Replicates/Station:2-10; Temporal Frequency:Monthly; Dominant Taxon/Taxa Studied:*Penaeus duorarum.*

346. Schier, D. E. 1965. Vermetid reefs and coastal development in southwest Florida. Ph.D. Dissertation, Florida State Univ., Tallahassee.

Sediments underlying The Ten Thousand Islands have been deposited over the past 5000 years during a marine transgression. Macrofauna and microfauna were used to interpret the depositional environment for these sediments mostly within the boundaries of ENP. A chain of gastropod (*Vermetus nigricans*) reefs formed along the coastline during the transgression of marine waters into the area about 3000 years ago. During a 6 ft increase in sea level, the reefs have grown larger and more numerous to form a barrier reef which has greatly affected the sedimentation throughout the Ten Thousand Islands. A system of bay bottom sands and silts, tidal pass sands, oyster bars, and mangrove peats has accumulated behind the reef barrier. Wave resistent reef cores, consisting of fused vermetid tubes, were built up as much as 9 ft. thick during the period of sea level rise. The ecology of *V. (Thyleodus) nigricans* is discussed, including factors which have controlled vermetid growth and reef structure.

Study Period:April-June, 1963 & February-March, 1964; Study Type:Quantitative; Biological Component:Fauna (mollusks); Gear Type:Cores; Number of Stations:68 (45 in ENP); Abiotic Parameters Measured:Tidal range & currents, sediment characteristics; Dominant Taxon/Taxa Studied:*Vermetus (Thyleodus) nigricans.*

347. Schier, D. E. 1969. Vermetid reefs and coastal development in the Ten Thousand Islands, southwest Florida. Geol. Soc. Am. Bull. 80:485-508.

Narrative same as in reference no. 346.

348. Schmidt, T. W. 1979. Ecological study of fishes and the water quality characteristics of Florida Bay, Everglades National Park, Florida. Final Rept. RSP-EVER N-36. Homestead, Fla., Everglades N.P., South Florida Research Center. 144 pp.

An ecological study of the fishes of Florida Bay (ENP) was directed toward acquiring baseline information on their relative abundance by number and biomass, habitat types, and the effect of environmental conditions on their distribution. A total of 182,530 fishes representing 128 species and 50 families were collected throughout Florida Bay. Their total biomass was 764.9 kg. An additional 21 species were identified from supplemental observations. In general the greatest numbers and biomass of the fishes occurred during the wet season (summer and fall months) whereas the lowest numbers and biomass occurred during the dry season (winter and spring months). The greatest abundance and diversity fishes was found in western Florida Bay followed by eastern and central Bay regions, respectively. The sampled areas of Florida Bay was found to support seagrass and macroalgal communities composed primarily of *Thalassia testudinum*, *Halodule wrightii*, and green algae, *Penicillus* sp. Salinity appeared to be the most important factor measured affecting fish distribution.

Study Period:May 1973-October 1976; Study Type:Qualitative, quantitative; Habitat:Banks, basins, bays shorelines,channels; Biological Component:fishes, benthic flora; Gear Type:Seine, otter trawl; Number of Stations:27; Number of Replicates/Station:1 (seine), 2 (trawl); Temporal Frequency;Biweekly(water quality), monthly/quarterly(biological); Abiotic Parameters Measured:Salinity, temperature, pH, DO, turbidity,wind speed/direction, cloud cover; Dominant Taxon/Taxa Studied:*Anchoa mitchili*, *A. hepsetus*, *Eucinostomus gula*, *Lagodon rhomboides*.

349. Schmidt, T. W. 1989. Food habits, length-weight relationship, and condition factor of young Great Barracuda, *Syphyraena barracuda*, (Walbaum) from Florida Bay, Everglades National Park, Florida. Bull. Mar Sci. 44:163-170.

The food habits of the great barracuda, *Syphyraena barracuda*, were investigated by examining the stomach contents of fish between 36 and 441 mm TL from the shallow grassbeds of Florida Bay (ENP). Juvenile barracuda less than 333 mm fed on small epibenthic fish. Goldspotted killifish, *Floridichthys carpio*, and rainwater killifish, *Lucania parva*, were the most common dietary items of juveniles. Food habits of juveniles were relatively constant with season and location within the estuary. Larger food organisms were consumed by adult barracuda. The calculated length-weight relationship for 97 barracuda (33-442 mm TL) was $\log_{10} W = -5.0148 + 2.8663 \log_{10} L$, and the mean condition factor was 0.497.

Study Period:May 1973-September 1976; Study Type:Semi-quantitative, quantitative; Habitat:banks, basins, bays, shorelines; Biological Component:Sportfish; Gear Type:Trawl & seines; Number of Stations:16; Number of Replicates/Station:1 (seine), 2 (trawl); Abiotic Parameters Measured:Salinity, temperature, DO, pH, turbidity, depth; Dominant Taxon/Taxa Studied:*Syphyraena barracuda*.

350. Schmidt, T. W. 1986. Food of young juvenile lemon sharks, *Negaprion brevirostris*, near Sandy Key, western Florida Bay. Fla. Sci. 49(1):7-10.

The food habits of the lemon shark, *Negaprion brevirostris*, were investigated by examining the stomach contents of juveniles between 58 and 100 cm TL from shallow grass flats near Sandy Key in western Florida Bay (ENP). Small demersal fish, mainly *Opsanus beta* and *Lagodon rhomboides*, and the commercially important pink shrimp, *Penaeus duorarum*, were the most common dietary items of *Negaprion* in the coastal marine waters. Small, fast-moving pelagic fishes were also found in the shark's diet.

Study Period:May 1973-July 1974; Study Type:Semi-quantitative, quantitative; Habitat:banks/beach; Biological Component:fish; Gear Type:Seine; Number of Stations:2; Number of Replicates/Station:1; Temporal Frequency:Monthly; Abiotic Parameters Measured:Salinity, temperature, DO, pH, turbidity, depth; Dominant Taxon/Taxa Studied:*Negaprion brevirostris*.

351. Schmidt, T. W. 1990. Life history aspects of selected dominant fishes and decapod crustaceans in the Whitewater Bay/Shark River estuary, Everglades National Park, Florida. Tech. Rept. (submitted). Homestead, Fla., Everglades N. P., South Florida Research Center.

This report presents the results of studies on the relative abundance, seasonal occurrence, food habits, size, growth, and reproductive biology of pink shrimp, *Penaeus duorarum*, blue crab, *Callinectes sapidus*, pinfish, *Lagodon rhomboides*, silver jenny, *Eucinostomus gula*, pigfish, *Orthopristis chrysoptera*, and silver perch, *Bairdiella chrysoura*, in the Whitewater Bay/Shark River area of ENP. Juveniles and adults were collected with trawl and gill nets from five sites among open water, bay habitats, March 1979 through May 1980. Pink shrimp was the most abundant animal studied. Catches varied by station and year. The greatest numbers of all animals studied were found at the Whitewater Bay sites. Catches of all species, except for blue crab, at Clearwater Pass 10 years before, were much higher than those during the course of the present study. Silver perch, silver jenny, and blue crab were found to spawn in park waters. Data was presented on sex ratio, size at first maturity, and length-weight relationships for most species. The stomach content analysis indicated that pink shrimp and pinfish were omnivores, while the remaining species were chiefly carnivorous. Spatial, temporal, and ontogenetic variations in diet composition were found among the species studied. These data suggest that abundance at a site was related more to seasonality (feeding, reproductive activity) than to environmental conditions experienced.

Study Period:March 1979-May 1980; Study Type:Quantitative, qualitative; Habitat:Open water bay; Number of Stations:5; Number of Replicates/Station:1-3; Biological Component:Non-game fish, commercial decapod crustaceans; Abiotic Parameters Measured:Salinity, temperature; Dominant species Studied:Pink shrimp, silver jenny.

352. Schmidt, T. W. 1979. Preliminary observations on fish predator-prey interactions in the Shark River estuary, Everglades National Park. Second Conf. on Natl. Parks, San Fran. Calif. Nov., 1979. Prog. Abstr.:63.

In this paper, preliminary results are reported on a fish food habits study currently in progress in the Shark river estuary, ENP. The purpose of this study, to gather information on the energy pathways and trophic relationships of dominant,

non-game fish and commercial crustaceans, was part of a larger study to identify the driving variables on the biotic resources within the coastal ecosystems of south Florida NPS areas. Species studied included: pinfish, *Lagodon rhomboides*, silver jenny, *Eucinostomus gula*, silver perch, *Bairdiella chrysoura*, Pigfish, *Orthopristis chrysoptera*, pink shrimp, *Penaeus duorarum*, and blue crab, *Callinectes sapidus*. In addition, life history information including length, weight, sex, and reproductive condition were documented. Between March and June 1979, most of the diet items of these species fell into three categories: mussels, *Brachidontes exustus*, polychates, and amphipods.-Adapted from author's abstract.

353. Schmidt, T. W. 1979. Seasonal biomass estimates of marine and estuarine fishes within the western Florida Bay portion of Everglades National Park, May 1973 to July 1974, p. 665-672. In R.N. Linn (ed)., Proc. 1st Conf. Sci. Res. Natl. Parks, Vol 1, Natl. Park Serv. Trans. Proc. Serv. No. 5., 1976.

Otter trawl and seine collections from western Florida Bay (ENP) were used to determine seasonal estimates of biomass of fishes during the period May 1973 to July 1974. A total of 95,344 individuals, distributed among 109 species and 45 families were collected in western Florida Bay. The most numerous species by number and weight included *Anchoa mitchilli*, *A. hepsetus*, *Lagodon rhomboides* and *Eucinostomus gula*. By seine, the largest number of individuals and the greatest biomass occurred in the collections during the wet season months (June to December 1973).

Study Period:May 1973-July 1974; Study Type:Qualitative, quantitative; Habitat:Banks, basins, shoreline, channels; Biological Component:Fish; Number of Stations:8 (seine), 4 (trawl); Number of Replicates/Station:1 (seine), 2 (trawl); Abiotic Parameters Measured:Salinity, temperature, DO, pH, turbidity, cloud cover, wind direction and speed; Dominant Taxon/Taxa Studied:*Anchoa mitchilli*, *A hepsetus*, *Eucinostomus gula*, *Lagodon rhomboides*.

354. Schmidt, T. W. and G. E. Davis. 1978. A summary of estuarine and marine water quality information collected in Everglades National Park, Biscayne National Monument, and adjacent estuaries from 1879 to 1977. Rept. T-519. Homestead, Florida, Everglades N.P., South Florida Research Center. 79 pp.

This report summarizes many published and unpublished reports of water quality information in ENP, BNP, and adjacent estuaries as the first step in the design, development, and implementation of a comprehensive monitoring system. Most of the data were collected in conjunction with short-term multi-disciplinary investigations. A total of 55 hydrographic studies were conducted dating from 1879 to the present, varying in duration from less than 1 year to over 5 years. Twenty-three studies were conducted in Florida Bay; 17 in the Everglades estuary; 16 in southern Biscayne Bay; 14 in Card-Barnes Sound; 7 in the Big Cypress estuary; and 5 in the area of the northern coral reef tract. A summary of the water quality parameters minimum and maximum are discussed. The greatest variations in salinity, temperature, DO, pH, and turbidity occurred in Florida Bay.

Study Type:Qualitative-review; Habitat:Estuarine and coastal marine.

355. Schold, G. P. 1977. Analysis of an indigenous foraminiferal biocenosis from Buttonwood Sound, Florida Bay. M.S. Thesis, Duke Univ., Durham, NC. 88 p. + App.

Using a rope cross staked to the bottom, samples of *Thalassia testudinum* and cores of sediment were collected over short lateral and vertical distances in Buttonwood Sound, Florida Bay (ENP), to study distribution patterns of the indigenous foraminiferal biocenosis. Very few foraminifera were found to be living on *Thalassia*, thus the quantitative analysis was restricted to those foraminifera living on or within the sediment. Using the factor-vector analysis, 10 vectors were selected in the R-mode that accounted for 90% of the variance in the data matrix, while in the Q-mode five vectors were selected that accounted for 94% of the total information contained in the data matrix. Shannon-Wiener species diversity indices for foraminifera in the sediment indicated that the environment was relatively unstable, resulting in broad niches populated by a few dominant species. *Archaias angulatus* was the only numerically dominant species.

Study Type:Quantitative; Gear Type:Cores, rope cross, hand; Number of Stations:16; Temporal Frequency:Once; Habitat:Basin/mud; Abiotic Parameters Measured:Sediment characteristics, salinity; Biological Component:Foraminifera; Dominant Taxon/Taxa Studied:*Archaias angulatus*.

356. Scholl, D. W. 1966. Florida Bay a modern site of limestone formation. Pgs. 282-288. IN Encyclopedia of Oceanography, R.W. Fairbridge, (ed.), N.Y. Reinhold Pub. Corp.

This is a summary of several of his other papers. He discusses physical setting, environmental factors, flora and fauna, unconsolidated calcareous sediments, and the value of shallow-water carbonate studies within the Florida Bay area of ENP.

Study Type:Qualitative, geological review.

357. Scholl, D. W. 1968. Mangrove swamps: Geology and sedimentology pgs. 684-688.IN The Encyclopedia of Geomorphology,, R.W. Fairbridge (ed). N.Y. Reinhold Pub. Corp.

A description and history of the mangrove swamps and sedimentary environments of southwest Florida including ENP is provided. Mangrove trees had evolved by Middle Cretaceous, about 120,000,000 years ago. Few occur north of the 30th parallel as frost kills them. Sediments are similar to salt marsh, which occupies the same sedimentological environment. Mangroves promote land buildup by trapping sediments, but do not significantly increase the rate of seaward or lateral growth of the coast.Mangrove swamps are strongly influenced by the coastal sedimentation pattern. The swamps in ENP are classified as open coast autochthonous peat swamps.-Adapted from an abstract obtained from a report on the geology of ENP. (See reference no. 519).

358. Scholl, D. W. 1969. Modern coastal mangrove swamp stratigraphy and the ideal cyclothem. In: E. C. Dapples & M. E. Hopkins, Environments of Coal Deposition, p. 37-61. Geo. Soc. Amer., Spec. Pap. No. 114. 61 pp.

This paper discusses the general stratigraphy of the ideal cyclothem of Late Paleozoic age in a modern succession of sedimentary units underlying the coastal mangrove swamps of southwestern Florida, mainly within the boundaries of ENP; this stratigraphic similarity has geologic importance with respect to coal formation. The sequence of sediments in Florida (nonmarine in the lower part to marine in the upper part) records a rise in sea level and is compared to the "ideal" cyclothem where coal is found in the central sedimentary unit; this reflects a duplication of sedimentary environments brought about by a rise in sea level across a low coastal platform supporting peat-depositing paralic and fresh-water swamps and forests. This suggests that the coal member of some cyclothems is formed in a swampy environment with a rise in sea level and the coal member, therefore, is in part a transgressive unit.

Study Type:Quantitative, qualitative; Habitat:Estuarine & coastal marine mangrove swamp; Biological Component:Flora; Gear Type:Cores; Abiotic Parameters Measured:Sediment characteristics.

359. Scholl, D. W. 1964. Recent sedimentary record in mangrove swamps and rise in sea level over the southwestern coast off Florida: Part 2. Marine Geol. 2:343-364.

Coastal swamps formed in the Whitewater Bay (ENP) area about 3,000 BP. Development of these swamps and the associated mangrove forest resulted from the landward penetration of marine water behind a rapidly constructed or pre-existing barrier (Cape Sable). Marine flooding took place over fresh-water swamps. In the Huston Bay complex region of the Ten Thousand Islands area, establishment of the coastal mangrove swamps initially developed along stream and river banks as a result of landward penetration of marine water. The Ten Thousand Islands are chiefly mangrove-crested bars and shoals of shelly quartz sand.-Adapted from an abstract obtained from a report on the geology of ENP. (See reference no. 519.)

360. Scholl, D. W. 1964. Recent sedimentary record in mangrove swamps and rise in sea level over the southwestern coast of Florida: Part 1. Marine Geol. 1:344-366.

Beneath the shallowly submerged coastal mangrove forest of SW Florida (ENP), marine and brackish-water sediments of recent age overlie fresh-water peat about 4000 years ago. This sedimentary succession is thought to be the record of a marine inundation of the western margin of the Everglades. The transgression sequence consists of a basal unit of autochthonous fibrous peat, an overlying allochthonous unit of peaty and calcareous shell debris or shelly quartz-rich sand and silt. The basal peat unit began to form 3,000-4,000 years ago, after cessation of calcitic mud formation. The environmental shift from fresh-water to brackish-water and marine conditions came in response to a more or less steady rise in sea-level and marine inundation of former mainland paludal swamps.-Adapted from an abstract obtained from a report on the geology of ENP. (See reference no. 519.)

361. Scholl, D. W. 1962. Sedimentary record of the Holocene Transgression across the southwestern margin of the Everglades, southern Florida. Coas. & Shallow Water Res. Conf., p 670-673. (Abs.).

A summary of studies on unconsolidated sediments in the mangrove estuarine swamps of southwest Florida is presented. The Holocene transgression across the southwestern margin of ENP is discussed. Unconsolidated calcareous - fine to very fine marine quartz sand has accumulated on nearly flat bedrock in the Ten Thousand Islands area (ENP). Peat found immediately over bedrock and under sand dates 4,000 B.P. (years before present). About 4 ft. of Holocene sediments have accumulated in the Ten Thousand Islands area, while only 2 ft. are found in Whitewater Bay. Sediments in Whitewater Bay consist of a surface layer of mangrove peat containing marine and brackish molluscs, underlain by layers of marine, brackish, and fresh, with a basal layer of calcareous mud with fresh water gastropods only. A 10 ft rise in sea level since 4,000 B.P. is reported.-Adapted from author's summary.

362. Scholl, D. W. 1963. Sedimentation in modern coastal swamps, southwestern Florida. Bull. Am. Assoc. Petr. Geol. 47(8):1581-1603.

Data on the physical, chemical, mineralogical, and biological characteristics of sediments in the coastal mangrove swamps of SW Florida mostly within the boundaries of ENP are presented. Surface sediments of the Ten Thousand Islands were mainly calcareous (shelly) or organically rich (peaty) calcareous quartz sands and silts. Deposits in Whitewater Bay were principally organic rich shell debris. Surface sediments of the two areas differed mostly because the prominent source of detrital quartz sands and strong tidal currents which exist in the Ten Thousand Islands were essentially lacking in Whitewater Bay.

Study Period:10 months; Study Type:Qualitative; Gear Type:Piston coring device, grab; Number of Stations:48; Number of Replicates/Station:1; Abiotic Parameters Measured:Salinity, sediment characteristics.

363. Scholl, D. W., F. C., Sr. Craighead and M. Stuiver. 1969. Florida submergence curve revised: Its relation to coastal sedimentation rates. Science 163:562-564.

New data, partially from the coastal environments of ENP, was used to modify the south Florida submergence curve. Eustatic sea level has risen continuously, at a generally decreasing rate, during the last 6500-7000 years to reach its present position. Coastal deposits accumulate at about the same rate as sea level rise, thus supporting the generalization that submergence rates largely determine as well as limit rates of coastal sedimentation in lagoonal and estuarine areas.

Study Type:Quantitative; Habitat:Estuarine & coastal marine; Number of Stations: Sediment samples (72).

364. Scholl, D. W. and F. C., Sr. Craighead. 1967. Recent geological history of the west coast of Florida; coastal mangrove swamps, and Florida Bay. Trans. Gulf Coast Assoc. Geol. Soc. 17:481. (Abs.).

No Abstract available.

365. Scholl, D. W. and M. Stuiver. 1967. Recent submergence of southern Florida: A comparison with adjacent coasts and other eustatic data. Geol. Soc. Am. Bull. 78(4):437-454.

Data on submergence from south Florida, including the coastal environments of ENP, were used to examine sea level rise. It was found that at 4400 yrs. before present, sea level was 4 m lower than today and that between 4400-3500 ybp sea level rose about 30 cm/100 yrs. At 3500 ybp, sea level 1.6 m below present level and the rise slowed to about 6 cm/100 yrs; from 1700 to the present, sea level rise is about 3 cm/100 yrs. These data indicate that sea level rose to the present level more or less steadily during the last 4400 years.-Adapted from an abstract obtained from a report on the geology of ENP. (See reference no. 519.)

366. Scholl, D. W. and M. Stuiver. 1967. Recent submergence of southern Florida: reply. Geol. Soc. Am. Bull. 78(9):1195-1198.

This paper is a reply in response to a discussion (Smith and Coleman 1967, no. 377 in bibliography) of Scholl and Stuvier's 1967 Florida submergence findings (no. 365). Smith and Coleman questioned the validity of south Florida submergence data based on their study of coastal sediments in Louisiana. However, the authors believe that the validity of their submergence data must rest chiefly on the case as they presented it. In view of this, the authors present additional elaboration on several essential arguments for submergence in southern Florida that were challenged by Smith and Coleman. For example, studies in ENP coastal mangrove swamp by F.C. Craighead serves further to document former stands of sea level rise using data on red mangrove peat build-up. Additional arguments are presented concerning root contamination, marine shells and evaluation of sample selection.

Study Type:Qualitative, geology review.

367. Schomer, N. S. and R. D. Drew. 1982. An ecological characterization of the lower Everglades, Florida Bay, and the Florida Keys. , U.S. Fish & Wild. Serv., Office of Biol. Servs., Wash. DC. FWS/OBS-82/58.1. 264 pp.

This report is a result of an extensive review of published and unpublished literature on pertinent ecological processes within the lower Everglades and Taylor Slough-Florida Bay (including coastal areas within the boundaries of ENP) area, and the Florida Keys, in an effort to focus on how the watershed functions as an integrated ecological system. A conceptual model of the study area identified four major ecological zones which were delineated by differences in physical-chemical background factors (substrate, climate, hydrology, water chemistry, etc.) which in turn produce characteristic ecological communities. The productivity of these communities with regard to fish and wildlife is partitioned by habitat and presented as a general model for each zone.

Study Type:Ecological review.

368. Scott, G. P., M. R. Dewy, L. J. Hansen, R. E. Owen and E. S. Rutherford. 1989. How many mullet are there in Florida Bay? Bull. Mar. Sci. 44:89-107.

A fishery independent sampling survey design was implemented in Florida Bay (ENP) to estimate the monthly biomass of mullet (*Mugil* spp.). The method was an application of aerial visual sampling, photogrammetric sampling, and shipboard sea-truth sampling. The method proved to be appropriate for silver mullet. Silver mullet biomass estimates were characterized by a high degree of variation while density estimates were found to be precise. Bias was estimated to result in underestimation of mullet biomass on the order of a factor of 9.6 to 19.0. Estimated monthly harvest of silver mullet in April-December 1984 ranged from 2.4 to 12.0% of the bias-adjusted estimates of biomass.

Study Period:January 1983 to June 1985; Study Type:Quantitative; Habitats:Basins, bays; Biological Component:Fish; Temporal Frequency:Bi-weekly to monthly; Gear Type:Purse seine, gill net; Dominant Taxon/Taxa Studied:*Mugil* sp. (includes *M. curema, M. trichodon, M. gaimardianus*).

369. Scott, G. P., M. R. Dewey, L. J. Hansen, R. E. Owen and E. S. Rutherford. 1985. Mullet stock biomass estimation using aerial visual, shipboard, and photogrammetric sampling. Fish & Wildl. Serv. Final Rept. to NMFS, Contr. No. ML1-85-15.

Narrative same as in reference no. 368.

370. Seaman, W. J. (ed.). 1985. Florida aquatic habitat and fishery resources. Fla. Chap. Amer. Fish. Soc.: Kissimmee, Fla. 543 pp.

This book summarizes and reviews over 1000 technical articles on the latest fishery and habitat-related scientific information of lakes, rivers, coastal marshes, mangrove forests, bays, and oceanic systems of Florida. Florida Bay and the Ten Thousand Islands, located within the boundaries of ENP, are discussed as major estuarine-lagoon systems. Conclusions are presented concerning Florida's major coastal and offshore fisheries which are dependent upon species related to nursery areas in estuaries and nearshore areas.

Study Type:Qualitative, fishery review.

371. Seba, D. B. 1970. Pesticide bioassay: Physical/chemical and biological effects of dieldrin on teleosts. Ph.D. Dissertation, Univ. of Miami, Coral Gables. 104 pp.

Chemically, dieldrin has been found to be very rapidly lost from static bioassay tests and biologically it is rapidly removed as shown in 3 estuarine fish species tested. These fish developed internal concentrations gradients 10,000 times ambient, resulting in TLm 's which are much too high. Using tarpon, *Megalops atlantica*, it was found that wild fish from south Florida estuaries, Sebastion Inlet to Key West (Coot Bay Pond in ENP) could be fully acclimated to accept the artificial testing situation without undo stress. Also, by careful control of diet, it was possible to grow and maintain tarpon free of pesticide. The TLm's obtained demonstrated the need for defining and controlling environmental parameters

when determining TLm's. Environmental contamination with chlorinated pesticides has been found in typical estuarine habitats and has entered into estuarine ecology by its biological uptake and magnification in the food chains. The rate of dieldrin accumulation in the blood of tarpon is dependent on environmental conditions and is independent of the total toxicity. It was determined that the more slowly the dieldrin is accumulated, the more it can be tolerated by the fish.

Study Type:Quantitative, qualitative; Habitat:Estuarine; Biological Component:Sportfish, nonfishery sp.; Gear Type:Seines, glass jars/water baths; Number of Stations:13 (1 in ENP); Abiotic Parameters Measured:Salinity, temp., pH, DO, $H_2S$, chlorinated pesticides; Dominant Taxon/Taxa Studied:Tarpon, *Megalops atlantica*.

372. Sengupta, S. and D. F. Merriam. 1985. Definition of major sub-environments in Florida Bay. Geol. Soc. Am., Abstr. Prog. 17(7):712.

Sedimentological, geochemical, and biological properties of the Recent sediments, and the relation of water characteristics such as salinity,, pH, DO, DCO, turbidity, Ca, and Mg collected in Florida Bay (ENP) were reported. Results indicate that (a) salinity increases from brackish to marine towards the center of the Bay, (b) pH is normal marine towards the center of the Bay, and it increases towards the mainland and the keys, (c) DO decreases towards the center of the Bay. Four Bay sub-environment were described including three peripheral ones (Northern, Gulf, and Atlantic) and a restricted Interior environment; all of which show distinct changes in orientation from winter to summer which are attributable to wind direction, nutrient supply, rainfall, water circulation, and basin configuration. Bay waters were found to be supersaturated with $CaCO_3$.-Adapted from authors' abstract.

373. Shaw, A. B. 1989. Distribution of mollusks in sediments of Florida Bay and reef tract. Bull. Mar. Sci. (Abstact). 44:523.

Collections of mollusks from bottom sediment samples of Florida Bay (mostly within the boundaries of ENP) and the adjoining reef tract can be classified into 9 major biofacies or assemblages, 5 minor and 4 subfacies. Most are recognizable by the dominant taxon (i.e., the most abundant taxon in the sample). The biofacies are diagnosed so that they can be used in the field. Salinity patterns seem to influence the distribution of the major biofacies in the interior of the bay, but the correspondence is not rigid, presumably because of fluctuations in salinity by season and year to year. Topography (or water depth) is more closely correlated with the distribution of some of the biofacies, although the total range of the depths within the bay is not large.-Adapted from author's abstract.

374. Smith, S. L. 1971. Distribution of recent foraminifera in Lower Florida Bay. Pgs. 116-120 In: W.D. Bock, G.W. Lynts, S.L. Smith, R.C. Wright, W.W. Hay, and J.J. Jones, eds. A Symp. of Recent south Florida foraminifera., Miami Geol. Soc., Mem. No. 1.

This study was undertaken to describe the benthonic foraminifera of Lower Florida Bay (partially within and/or adjacent to the boundaries of ENP), and to consider ecologic factors as they may influence observed distributional patterns. A total of 61 genera and 150 species were present in the total population. The foraminiferal fauna seems to be highly environmentally tolerant. The productivity of an area did not demonstrate a close relationship to any measured environmental parameter.

Study Period:March 1963; Study Type:Qualitative, quantitative; Gear Type:Cores, grab samples; Number of Stations:26 samples; Habitat:Bottom sediment; Biological Component:Foraminifera; Abiotic Parameters Measured:Temperature, water depth; Dominant Taxon/Taxa Studied:*Ammonia beccarii.*

375. Smith, T. J.,III, J. H. Hudson, G. V. N. Powell, M. B. Robblee and P. J. Isdale. 1989. Freshwater flow from the Everglades to Florida Bay; a historical reconstruction based on fluorescent banding in the coral *Solenastrea bournoni.* Bull. Mar. Sci. 44:274-282.

Relationships between the fluorescent banding pattern in the hermatypic coral *Solenastrea bournoni* and freshwater flow in the Shark River Slough (SRS) and Taylor Slough (TS), the two major outlets of freshwater from the Everglades, were investigated using cores taken from a coral colony growing in the Petersen Key Basin region of Florida Bay (ENP). The fluorescence record shows a decline in annual flow between 1912 and 1932; fluorescence is significantly higher prior to 1932 than late in the record (1932 and later) and is interpreted as recording decreased freshwater flow from the Everglades into Florida Bay by as much as 59%. The onset of decreased flow corresponds with the timing of construction of drainage canals to the east and south of Lake Okeechobee. These canals diverted water into the Atlantic Ocean which would normally have flowed into the Everglades from Lake Okeechobee.

Study Period:October 1986; Study Type:Quantitative; Gear Type:Cores; Number of Stations:1; Habitat:Bedrock; Biological Component:Hermatypic coral; Abiotic Parameters Measured:Water flow, groundwater stage; Dominant Taxon/Taxa Studied:*Solenastrea bournoni.*

376. Smith, W. G. 1968. Sedimentary environments and environmental change in the peat-forming area of south Florida. Ph.D. Dissertation, The Pennsylvania State Univ., University Park, Pa. 254 pp.

In the Everglades three principal types of peat are formed, each a product of one of the three principal types of environments of that area. The aquatic environment forms the most peat, followed by the emergent herbaceous, and shrub-tree environments. Differing water relations may have much significance in the differentiation of the Everglades environments and in the stratification of peat types. In the tidal area, *Rhizophora* is the most common type and they appear to have higher minimal ash content than freshwater types. Carbonate muds in the Everglades are mostly calcitic in composition with a freshwater gastropod assemblage, while in the tidal area aragonitic muds with brackish and marine faunas are predominant. Radiocarbon dating of the shell beach ridge of the Cape

Sable area.indicate the ridges began to form 2000 yrs. ago. Freshwater peat types were found to intervene between brackish peat types and bedrock or calcitic muds, which is in contrast somewhat to Scholl (1964, no. 360 in bibliography) and Davis (1940, no. 84).

Study Period:Apr 1964, Jun-Sep 1966, Jul-Oct 1967; Study Type:Quantitative; Habitat:Rivers, bays, beaches, channels, marsh; Gear Type:Piston corer; Number of Stations:46 (41 in ENP); Biological Component:Peat; Dominant Taxon/Taxa Studied:*Rhizophora*.

377. Smith, W. G. and J. M. Coleman. 1967. Recent submergence of southern Florida: Discussion. Geol. Soc. Am. Bull. 78:1191-1194.

This paper presents information collected in the coastal environments of ENP as it pertains to the south Florida submergence curve. Many of the dated samples reported by Scholl and Stuvier (1967, no. 365 in bibliography) may not be as closely related to past sea level as their small margins of error would suggest. More evidence is needed on the true nature of the materials dated and the environments in which they accumulated. In the low-relief area of the Everglades and adjacent swamps (ENP), the materials used probably reflect the last phase of sea level rise. The authors suggest that more precise determinations are needed before acceptance of the area as a standard of comparison for other coasts can be made.

Study Type:Qualitative, geological review.

378. Smith, W. G. and H. H. Roberts. 1976. Coastal change at Cape Sable, Monroe County, Florida. Louis. State Univ. Coas. Stu. Inst.

A report on shoreline change in ENP indicates that the three points of Cape Sable are littoral accumulative forms of successively accumulated beach ridges consisting of predominantly molluscan shell debris. According to radiocarbon analysis, these ridges have been in their present position 1200-2000 years. Results reveal that older phases of coastal change exist inland from the three capes in the form of low carbonate mud ridges similar to those found along the present Florida Bay shoreline.-Adapted from an abstract obtained from a report on the geology of ENP. (See reference no. 519.)

379. Snedaker, S. C. 1989. Overview of ecology of mangrove & information needs for Florida Bay. Bull. Mar. Sci. 44:341-347.

This paper presents a discussion of the mangrove forest areas which border Florida Bay (ENP). These areas have provided research data and information which have formed the bases both for conservation laws and for the advances in mangrove research at other laboratories throughout the world. In this regard, the structural diversity of Florida Bay mangroves has been documented, but little research has been done on functional diversity, particularly as it relates to the nearshore estuarine flora and fauna. The author postulates that the quantity, quality, and timing of the fluxes of dissolved organic matter from different mangrove forest types may have a significant regulatory role in the structure and in the functioning of estuarine populations. It is suggested that this postulation focuses on a new area

in chemical ecology which could lead to important research findings on the interrelationships between mangrove forest types and the biological organization of estuarine communities.

Study Type:Review; Habitat:Estuarine and coastal marine; Dominant Taxon/Taxa Studied:Red mangrove, *Rhizophora mangle*.

380. Sogard, S. M., G. V. N. Powell and J. G. Holmquist. 1987. Epibenthic fish communities on Florida Bay banks: relations with physical parameters and seagrass cover. Mar. Ecol. Prog. Ser. 40:25-39.

Epibenthic fish communities residing in Florida Bay (ENP) seagrass beds on shallow (<0.5 m) mudbanks were quantitatively sampled with a throw trap. Four sites, representing 4 different sub-environments of Florida Bay, differed widely in species composition and densities of individual species; results of discriminant function analysis showed that fish communities at the 4 sites were distinct. It was proposed that species composition at different sites was a result of complex interactions between habitat quality and larval availability; restricted water circulation acted as constraints on larval availability. Multiple regression analysis indicated that depth, sediment structure, and seagrass structural complexity were important determinants in species richness and fish density. Physical stress may limit species richness.

Study Period:2 years (1984-85); Study Type:Quantitative; Gear Type:Fish (1 $m^2$ throw trap), Seagrass (15.3 cm cores); Number of Stations:4; Temporal Frequency:3 series/year; Number of Replicates/Station:Fish (18-24), Seagrass (36-48); Habitat:Seagrass; Biological Component:Epibenthic fishes, seagrasses; Abiotic Parameters Measured:Salinity, temperature, depth, sediment characteristics; Dominant Taxon/Taxa Studied:*Floridichthys carpio*, *Lucania parva*, *Opsanus beta*, *Gobiosoma robustum*.

381. Sogard, S. M., G. V. N. Powell and J. G. Holmquist. 1989. Spatial distribution and trends in abundance of fishes residing in seagrass meadows on Florida Bay mudbanks. Bull. Mar. Sci. 44:179-199.

Studies on fishes inhabitating seagrass beds on shallow mudbanks in Florida Bay were conducted from 1984 to 1987 using throw traps to sample the epibenthic species and gill nets to capture the mobile species occupying the overlying water column. Results showed that there was a strong heterogeneity in species composition and abundances of both components across different sub-environments of the Bay. The Interior section contained few epibenthic species relative to sites on the Bay periphery; highest densities were recorded for *Lucania parva*, water column species also displayed low species richness. A trend from estuarine to marine conditions in salinity regime, seagrass growth, and fish density was found in the NE sub-environment. The role of biotic and abiotic factors in structuring fish communities on banks was illustrated in a conceptual model. It was concluded that water circulation and salinity play a more influential role in Florida Bay than in more congruous seagrass ecosystems.

Study Period:1984-1987; Study Type:Quantitative; Habitat:Seagrass-covered mudbanks; Gear Types:Throw trap & gill nets (fishes), cores (seagrasses); Number

of Stations:6; Number of Replicates/Station:18 (throw traps), 144 (gill nets), 36 (seagrasses); Biological Component:Fishes, seagrasses; Abiotic Parameters Measured:Water level, salinity, temperature, sediment characteristics; Dominant Taxa/Taxon Studied:*Lucania parva, Arius felis, Strongylura notata, Microgobius gulosus, Floridichthys carpio.*

382. Sogard, S. M., G. V. N. Powell and J. G. Holmquist. 1989. Utilization by fishes of shallow, seagrass-covered banks in Florida Bay: 1. Species composition and spatial heterogeneity. Env. Biol. Fish. 24:53-65.

Species composition and relative capture rates of water column fishes occurring on the shallow (<1 m), seagrass-covered mudbanks of Florida Bay (ENP) were assessed using small-mesh gill nets at four sites. It was determined that the fauna was mostly temperate, with few tropical representatives, and was similar to the fish community of the adjacent basins. There was high variability in the catch across the Bay, reflecting heterogeneity in both the physical environment and the seagrass canopy. The Gulf site had the highest species richness and highest capture rates of individual species, relative to other sites. It was hypothesized that higher densities of potential prey, greater available foraging area, and organically rich sediments are influential in the greater utilization of the bank. The greater exchange of western Florida Bay with open Atlantic or Gulf waters was suggested as a secondary factor influencing species richness; non-resident species may occur more often on western banks than in isolated interior sections of the Bay.

Study Period:2 years; Study Type:Quantitative; Gear Type:Variable mesh gill net; Number of Stations:4; Temporal Frequency:5 during ecologically distinct seasons (dry/wet/transitional); Number of Replicates/Station:144 (ea. 30 min over 72 hr period); Habitat:Water column; Biological Component:Water column fishes; Abiotic Parameters Measured:Temperature, salinity, water depth; Dominant Taxon/Taxa Studied:Clupeidae, Ariidae, Gerreidae, Sparidae, Sciaenidae, Mugilidae.

383. Sogard, S. M., G. V. N. Powell and J. G. Holmquist. 1989. Utilization by fishes of shallow, seagrass-covered banks in Florida By: 2. Diel and tidal patterns. Env. Biol. Fish. 24:81-92.

Investigation was made into the diel and tidal patterns in the occurrence of water column fishes on four shallow banks in Florida Bay (ENP), using continuous gill net sets. Patterns in capture rates were presumed to indicate movement of fishes on and off the seagrass-covered banks. *Arius felis, Mugil gyrans, Opisthonema oglinium, Harangula jaguana, Elops saurus, Lutjanus griseus,* and *Bairdiella chrysoura* were nocturnally active while diurnal species included *Eucinostomus gula, Lagodon rhomboides,* and *Mugil cephalus.* Different activity patterns were found for several species relative to tidal stage. Cycles of fish utilization of the bank habitat are proposed to be related to both availability of prey (diel patterns) and water level (tidal patterns). These cycles in turn influence activity patterns of predators foraging on these fishes.

Study Period:2 years (March 1984-July 1985); Study Type:Quantitative; Gear Type:Variable mesh gill net; Number of Stations:4; Temporal Frequency:5 series (March, July, November 1984; March, July 1985); Number of Replicates/Station:144 (ea. 30 min./72 hr period; Habitat:Water column; Biological

Component:Water column fishes; Abiotic Parameters Measured:Water level; Dominant Taxon/Taxa Studied:*Eucinostomus gula, Opisthonema oglinium, Lagodon rhomboides.*

384. Sorensen, C. E. 1985. Quantitative analysis of the carbonate sediments in Shell Key Basin, Florida Bay. The Compass 62(2):97-105.

In July 1982 sediment and water samples from Shell Key Basin located within and/or adjacent to the extreme SE boundary of ENP in Florida Bay, were collected from 13 stations and analyzed for temperature, salinity, dissolved $CO_2$ and $O_2$, pH, and grain-size. It was deduced from various statistical analyses including calculation of a correlation matrix, a cluster analysis, principal-component analysis and regression analysis that the strongest predictive variables for grain-size class are salinity, $CO_2$, and $O_2$ and that algae play a larger role in sediment production in the Basin than mollusks. Other relationships between sediment, pH, temperature, and water depth are discussed.

Study Period:July 1982; Habitat:Water column, mud; Study Type:Quantitative; Number of Stations:13; Abiotic Parameters Measured:Temp, Sal, $CO_2$, $O_2$, pH, depth; Gear Type:Sediment (by hand).

385. Sorensen, C. E. 1983. Relationship of geochemical, biological, and sedimentological parameters in basins in Florida Bay, Florida. Geol. Soc. Am., Abstr. Prog. 15(1):1.

This abstract presents information on recent studies of geochemical ($CO_2$, $O_2$, pH, salinity), biological, and sedimentological (turbidity, grain size, composition) parameters within three basins (Maderia Bay, Captain and Shell Key basins) of Florida Bay (ENP). Preliminary results indicate that in all basins: as turbidity and pH increase, $O_2$, $CO_2$ and salinity decrease; proximity of sampling sites to tidal channels effects sedimentological and geochemical parameters; faunal and floral distributions which effect geochemical parameters are dependent on depth. Between basins, grain-size and floral-faunal diversity increases in those basins with "normal" marine geochemical parameters.-Adapted from author's abstract.

386. Sorensen, C. E. 1985. A study of active processes affecting grain-size and chemical distributions in three selected basins of Florida Bay, Florida. M.S. Thesis, Wichita State Univ., Wichita, KS. 142 pp.

Benthonic flora and fauna, sediment, and water samples were collected and analyzed at 45 sampling stations in three basins (Shell and Crab Key Basins, and Maderia Bay) within the Florida Bay portion of ENP. Statistical parameters indicated that physical processes controlled grain-size distributions in Shell and Crab Key Basins, but biological processes controlled grain-size distributions in Maderia Bay. Strontium analysis indicated that most of the basin sediments were derived from molluscs, rather than algae as previously believed. Chemical conditions were unfavorable for $CaCo_3$ precipitation. Thalassia density was related negatively to coarse grains in only one basin.

Study Period:July 1982; Study Type:Quantitative; Habitat:Basins, bay; Biological Component:Flora & fauna; Gear Type:Visual estimates;Temporal Frequency:Once; Number of Stations:45; Abiotic Parameters Measured:Salinity, temperature, depth, DO, $CO_2$, pH, turbidity, grain-size distribution, sediment elements-Ca, Al, Mg, Si, Ti, Fe, Sr, and K.

387. Sorensen, C. E. and D. F. Merriam. 1985. Geochemical and grain-size distribution in three basins in Florida Bay. Geol. Soc. Am., Abstr. Prog. 17(3):19.

Sediment geochemistry and grain-size studies were carried out in three basins in the Florida Bay portion of ENP. Using X-ray fluorescence spectrometry selected cations Ca, Sr, Si, Ti, Al, K, and Fe were analyzed for in the sediments. In Shell Key basin, highest concentrations of Ca and Si were found in the center of the basin, and on the northern margin, respectively. No areal orientation was found for the elements in Crab Key basin, while highest concentration of all elemental components occurred along the southern margin in Maderia Bay. Between basin comparisons were also given. Using a sieve analysis, five different sediment types were classified in the basins studied: Shell Key Basin contained the coarsest sediments, followed by Crab Key Basin and Maderia Bay, respectively.

388. Spackman, W., A. D. Cohen, P. H. Given and D. J. Casagrande. 1974. The comparative study of the Okefenokee Swamp and the Everglades-Mangrove swamp marsh complex of southern Florida: Fieldtrip Guidebook, Coal Research Section, Geol. Soc. Amer. Conv. Field Trip No. 6. 265 pp. + 3 App.

This guidebook reviews published and unpublished studies in the Okefenokee Swamp and in the swamp-marsh complex of southern Florida (mostly within the boundaries of ENP) as they are related to understanding the formation of coal seams and coal constituents. In the coastal regions of ENP data were provided from cores taken from 1957-74. Different kinds of peat, which represent the progenitor of a different coal type, are forming in each area. These studies result in an improved knowledge of: 1) the recent geological and vegetational history of the areas involved, 2) the physical, chemical, and biological conditions characterizing the many different environments, and 3) the interrelationships of these conditions in the ecosystems involved. In the coastal mangrove province of ENP, the geological, botanical, and chemical aspects of the following areas were discussed: western Florida Bay, Whitewater Bay, Shark, Little Shark, Joe, and Harney Rivers.

Study Period:1957-74 (In ENP); Study Type:Review; Habitat:Variable; Biological Component:Flora; Dominant Taxon/Taxa Studied:*Rhizophora mangle*.

389. Spackman, W. and C. P. Dolsen. 1962. The characteristics of modern organic sediments and their use in the identification, description, and interpretation of carbonaceous rocks and rock sequences, p. 155-160. IN Proc. 1st Natl. Coas. & Shallow Water Res. Conf. 1961, Wash. DC. 897 pp. (Abs.).

Narrative same as in reference no. 391.

390. Spackman, W., C. P. Dolsen and W. L. Riegel. 1966. Phytogenic organic sediments and sedimentary environments in the Everglades mangrove complex. Pt. 1. Evidence of a transgressing sea and its effects on environments of the Shark River area of southwestern Florida. Paleontogr. Abt. B. 117:135-152.

Studies concerning the plant-derived sediments that represent the progenitors of coal seams, were conducted in the fringing mangrove swamps of the Shark River area in ENP. An analyses of these samples have shown distribution patterns for uranium and manganese but none for sulfur, while the pollen assemblage in the sediment reflects the ecological amplitude of *Rhizophora* and *Avicennia*. Cores obtained from the carbonaceous sediment at the coastline and offshore to a distance of 1 1/2 miles, showed that autochthonous peat extends out beneath the Gulf waters. Evidence is presented of a recession of the coastline and a rise in sea level over the last 4000-5000 years with the net effect of erosional and sedimentary processes being a gradual dissection of the previously developed blanket of organic sediment.

Study Type:Quantitative, qualitative; Gear Type:Cores; Number of Stations:30; Number of Replicates/Station:1-2; Habitat:channel bank near-surface sediments & surface sediments offshore (Shark River area); Biological Component:Peat; Dominant Taxon/Taxa Studied:*Rhizophora*, *Avicennia*.

391. Spackman, W., W. L. Riegel and C. P. Dolsen. 1969. Geological and biological interactions in the swamp-marsh complex of southern Florida.IN E.C. Dapples & M.E. Hopkins, Environments of Coal Deposition p. 1-37. Geol. Soc. Am., Spec. Pap. No. 114. 61 pp.

The development and perpetuation of extensive coal-forming environments require establishment and maintenance of a delicate balance between certain geological and biological processes including the contribution of plant communities to the accumulating sediments, plant succession and migration along with environmental factors-rate of subsidence, rate of influx, and tide height which have profound effects on the vegetation and, hence on peat-forming environments. The southwestern coast of Florida (ENP), is bordered by a Mangrove Fringe Complex which includes a variety of environments ranging from hammocks and natural levees to offshore islands. The Mangrove Swamp which occupies the greatest area in the Fringe Complex. Under the impact of a transgressing sea this environment has produced carbonaceous sediment that contains a high mineral content, is chemically distinct, and yields a pollen flora with large concentrations of *Rhizophora* but little *Avicennia*. Currently the Mangrove Fringe environments are migrating over the sediments formed in the more inland Everglades Complex.

Study Type:Quantitative, qualitative; Habitat:Estuarine/coastal marine mangrove swamp (ENP); Number of Stations:30 probings along a grid from offshore Cape Sable, inland 40 mi + 3 sites at Big Sable Creek, Shark River mouth, and NW Cape; Abiotic Parameters Measured:Sediment characteristics.

392. Spackman, W., D. W. Scholl and W. H. Taft. 1964. Field guidebook to Environments of Coal Formation in southern Florida. Geo. Soc. Amer. Conv. Fieldtrip. 67 pp.

Narrative same as in reference no. 388. This report also presents raw chemical data not included in reference no. 388.

393. Stehli, F. G. and J. Hower. 1961. Mineralogy and early diagensis of carbonate sediments. J. Sed. Petr. 31:358-371.

This study concentrated on the chemistry and mineralogy of carbonate sediments and on the chemical and mineralogical changes which they undergo during alteration into carbonate rock. All of the comparable Pleistocene carbonate rocks and most of the Recent carbonate sediments studied were obtained from southern Florida, mainly within the boundaries of ENP in Florida Bay. Most sediments were found to consist of aragonite, high-magnesium calcite, and magnesium calcite. Shallow water carbonate sediments contain about 70% of unstable forms of $CaCO_3$, with aragonite predominating while in deep water sediments magnesium calcite dominates; compositional difference are due to the contributions of skeletal material in the two environments. Pleistocene rocks consisted mainly of magnesium calcite. Diagensis of carbonate sediments is accompanied by an important loss in the level of abundance of magnesium, strontium, barium, and manganese and the significance of volume changes which accompany diagensis can not yet be assessed.

Study Type:Qualitative, quantitative; Habitat:Mangrove swamp, reef, open banks, basins; Number of Stations:Approximately 40 in Florida Bay; Abiotic Parameters Measured:Sediment characteristics (mineralogy).

394. Steinen, R. P., R. B. Halley and S. L. Videlock. 1977. Holocene dolomite locality in Florida Bay. Am. Assoc.Petrol. Geol. Bull. 61(5):833. (Abs.).

This paper reports on the identification of dolomite in unlithified Holocene sediments recovered from Cluett Key (ENP) in Florida Bay. It was common in cores from Cluett Key, but absent in the adjacent mudbanks that surround the island. The dolomitic island is underlain by a peat with a $C^{14}$ age of 3879 B.P. The origin of this dolomite is under investigation; its distribution suggests a relation with some island processes most likely the formation and trapping of brackish and hypersaline ground waters in the low permeability island muds. The dolomite was found to be of Holocene age based on its areal distribution, stratigraphy, abundance, chemistry, and grain size.-Adapted from authors' abstract.

395. Steinker, D. C. 1977. Foraminiferal studies in tropical carbonate environments: South Florida and Bahamas. Fla. Sci. 40(1):46-61.

Those who seek to understand ancient carbonate rocks must first pursue knowledge of modern carbonate depositional environments. Those who study modern carbonates in tropical areas quickly learn that plants and animals exert significant influences upon the depositional environment. Many geologists and paleontologists, therefore, have entered into studies of modern organisms and their effects upon the carbonate sedimentary framework. The foraminifera are important both as members of the biota and as skeletal constituents of the carbonate sediments in areas such as south Florida, particularly within the Florida Bay portion of ENP, and the Bahamas. Methods of direct observations are suggested

to distinguish live from dead specimens as rose benegal is an unreliable indicator of living fauna. The assemblage among the bottom sediments commonly is sorted by waves and currents and does not reflect the biocoenosis of an area. Environmental factors which determine the distribution of the living specimens must be distinguished from those that determine the thantocoenosis in the sediments. More biological studies are needed for a better understanding of foraminifera in their natural habitats.

Study Type:Review, qualitative; Biological Component:Fauna; Dominant Taxon/ Taxa Studied:Foraminifera.

396. Sternberg, L. and P. K. Swart. 1987. Utilization of freshwater and oceanwater by coastal plants of south Florida. Ecology 68:1898-1905.

The coastal vegetation of southern Florida is undergoing dramatic changes due to instability of the ocean water-freshwater boundary. These vegetation changes will be determined by the response of each particular species to saline water, particularly whether it can use ocean water or not. In this study, isotopic data were used to indicate that plants toward the center of Florida keys (Cluett Key in western Florida Bay, ENP) were using freshwater while those toward the edge were using ocean water. It was found that the hydrogen and oxygen isotopic composition of plant water yielded a mixing line between freshwater and ocean water. The isotopic ratios of stem water for species found in hardwood hammocks were confined to the freshwater end of the line, followed by values of stem water from mangrove margin species. Species found in mangroves, however, had water ranging from values of typical of ocean water to values typical of freshwater. This variability is consistent with the hypothesis that mangroves are fully capable of growing in freshwater, but are limited to saline habitats because of competitive exclusion by fast-growing glycophilic plants.

Study Period:February-August 1986; Study Type:Quantitative; Habitat:Florida keys, Cluett Key in ENP & Elliott Key in BNP; Number of Stations:4 on each key; Abiotic Parameters Measured:Hydrogen/oxygen isotope ratios of plant water; Dominant Taxa/Taxon Studied:Mangrove (*Rhizophora mangle, Avicennia germinans*), Mangrove margin sp. (*Borrichia frutescens*), Hardwood hammock sp. (*Ficus aurea, Acrostichium aureum*).

397. Stewart, K. W. 1961. Contributions to the biology of the spotted seatrout, (*Cynoscion nebulous*) in the Everglades National Park, Florida. M.S. Thesis, Univ. of Miami, Coral Gables, Fla. 103 pp.

Studies were conducted on the biology of the spotted seatrout taken mostly from sportfishermen and charterboat catches in ENP from August 1959 to July 1960. Using scale annuli, it was found that the oldest observed age for all fish was 7 years, females grow more rapidly and live longer than males. There was no difference in the size at first maturity among sexes. The spawning period was bimodal, with a spring peak in May, and a fall peak in September; ripe fish of both sexes were present every month of the year. Spotted seatrout feed mainly on pink shrimp.

Study Period:August 1959 to July 1960; Study Type:Qualitative; Habitat:Estuarine/coastal marine; Gear Type:H & L, bottom trawl; Biological Component:Sportfish; Abiotic Parameters Measured:Water temperature; Dominant Taxon/Taxa Studied:*Cynoscion nebulous*.

398. Stockman, K. W., R. N. Ginsburg and E. A. Shinn. 1967. The production of lime mud by algae in south Florida. J. Sediment. Pterol. 37(2):633-648.

A study was made on the origin of recent lime muds in south Florida, mostly within the northeast interior of Florida Bay (ENP). Comparison of the annual production of fine aragonite mud (<15 ug) by the post-mortem disintegration of fragile algal skeletons, showed the algae, *Penicillus*, to be a major sediment contributor, accounting for all the fine aragonite mud in the inner Florida Reef Tract and 1/3 of the same material in northeast Florida Bay. The contribution of 3 other abundant algal species is assessed as well as the significance of mechanical breakdown of skeletons, molluscs, and corals. Movement of lime muds from their production sources to areas of accumulation such as the banks in western Florida Bay is discussed. It is suggested that plant and animal skeletons have been major sources of fine lime sediment in the past.

Study Period:1959-1961; Study Type:Qualitative, quantitative; Habitat:Basins, bank, inner reef tract; Biological Component:Flora; Number of Stations:23 (7 in Florida Bay) ; Temporal Frequency:Every 20 days; Abiotic Parameters Measured:Salinity; Dominant Taxon/Taxa Studied:*Penicillus*.

399. Stoneburner, D. L. and J. A. Kushlan. 1982. Heavy metal burdens in American Crocodile eggs from Florida Bay, Florida, USA. J. Herpetol. 18(2):192-193.

Samples of eggs of the American crocodile, *Crocodylus acutus*, were collected in 1980 from the Florida Bay portion of ENP and analyzed for heavy metal concentrations. The results were compared to studies made in 1972 and 1977. In the current study, there were no significant differences in heavy metal concentrations among the eggs sampled. The concentrations of 8 of the heavy metals were significantly higher in the shell samples than in the albumin-yolk samples; the reverse was true for mercury. The authors tentatively concluded that the mean concentration of lead and mercury in *Crocodylus* eggs have increased since 1972.

Study Period:1980; Study Type:Quantitative; Biological Component:Marine Reptile; Dominant Taxon/Taxa Studied:*Crocodylus acutus*.

400. Studer, H. P. 1963. Electron Microscope study of aragonite crystals in marine sediments. Am. Assoc. Petrol. Geol. Bull. 47(2):371. (Abs.).

This paper examined the occurrence of aragonite needles in the carbonate mud of surface sediments of Florida Bay, the Florida Keys, and the Great Bahama Bank. Older views on the origin of the aragonite needles support inorganic precipitation, whereas more recent theories favor a biogenic formation and link the mud particles to the aragonite sheath of algae, mainly *Penicillus*, *Rhipocephalus*, and *Halimeda*. Electron microscope studies show a remarkable similarity between the aragonite

formed on the algal surface, and the aragonite in the carbonate mud. The closely interwoven systems of plant material and aragonite needles supports the suggestion of the algal substrate acting as a matrix for the aragonite formation.- Adapted from author's abstract.

401. Swart, P. K., D. Berler, D. McNeill, M. Guzikowski, S. A. Harrison and E. Dedick. 1989. Interstitial water geochemistry and carbonate diagenesis in the sub-surface of a Holocene mud island in Florida Bay. Bull. Mar. Sci. 44:490-514.

An assessment was made of the diagenetic reactions in the sub-surface of a Holocene island in Florida Bay (ENP), based on a core from Crane Key. Pore waters, analyzed for major, trace and stable isotopic (C and O) compositions were compared with the mineralogy, strontium concentration and carbon and oxygen of the bulk sample and isolated dolomite. It was reported that pore waters were highly saline (80-88 g.kg) and a decrease in magnesium and strontium calcite ratios may be attributable to the dissolution of high magnesium calcite and perhaps the precipitation of dolomite. More than enough $Mg^{2+}$ has been available from the dissolution of high magnesium calcite to account for the observed dolomite. The dolomites which were analyzed in this study did not form contemporaneously with deposition, but between 2,600 B.P. and the present day.

Study Period:September 1985; Study Type:Quantitative; Gear Type:Push corer; Habitat:Island sub-surface mud; Number of Stations:1; Abiotic Parameters Measured:Salinity, pH, alkalinity, strontium, magnesium, calcium, sulfate and chloride concentrations, carbon and oxygen isotopic composition.

402. Tabb, D. C. 1966. The estuary as a habitat for spotted seatrout (*Cynoscion nebulous*). A symposium on estuarine fisheries. In Amer. Fish. Soc., Suppl. to Trans Amer. Fish. Soc., Vol. 95, No. 4. Spec. Pub. No.3, pp 59-67.

This article presents a summary of previous research including studies conducted in ENP. Major topics discussed include food habitats, spawning, salinity and temperature relationships, development of postlarvae and juveniles, and migrations. Early life history is carried out within the estuary. Future research recommendations involve spawning ecology and regional differences in habits of this species.

Study Type:Review, biological.

403. Tabb, D. C. 1967. Prediction of estuarine salinities in Everglades National Park, Florida, by the use of ground water records. Ph.D. Dissertation, Univ. of Miami. Coral Gables, Fla. 107 pp.

In this study a strong relationship between ground water level as expressed by elevation of water height in specified wells in the respective watersheds (Taylor Slough & Shark River Valley) and salinity in the estuaries of ENP was found. The precision of prediction of salinity increases with proximity to the land from which the water supply comes. Local rainfall has little effect in changing salinity except at the end of the dry season and drought. These studies indicate that ground water discharge is by far the most significant factor in moderating coastal salinities in

ENP. It was determined that nearshore Florida Bay salinities will rise above 50 ppt whenever ground water elevations in the Homstead well fall below 2 ft. above MSL; offshore sites vary between 25-35 ppt when water levels fall between 2 to 5.5 ft above MSL, while 6 ft. water levels will result in abrupt declines of salinity, 11-15 ppt. It was concluded that to refine the prediction method, hourly salinity measurements, and current direction and velocity meters would eliminate most of the errors.

Study Period:1957-1962; Study Type:Quantitative; Number of Stations:Ground water level sites - 3 (P-35, P-38, & Homestead), Salinity sites - Florida Bay 47 (10 used in correlations), Whitewater Bay/10,000 Islands variable (6 used in correlations); Temporal Frequency:Water level sites-monthly, salinity-monthly/ bimonthly/variable; Abiotic Parameters Measured:Ground water levels, salinity; Habitat:Estuarine, coastal marine.

404. Tabb, D. C. 1963. A summary of existing information on the fresh-water brackish-water and marine ecology of the Florida Everglades region in relation to fresh-water needs of Everglades National Park. The Marine Lab., Univ. of Miami. ML No.63609. 85 pp.

This report reviews the literature (published and unpublished) on Everglades water studies in relation to the water supply problems of ENP. Based on the examination of over 400 references pertaining in some way to the problem, it was found that there have been pronounced changes in water level, water supply, and water dispersal in and around the park; that major changes in the water shed took place prior to the finalization of the park boundary in 1947, and that the park biota had adjusted to these changes by that time. Results also showed that, although the park cannot be returned to pre-drainage conditions, there should be sufficient water during most years to maintain the park ecology at the 1947-57 level. Hypersaline conditions and the effects of the reduction of freshwater runoff to Florida Bay was discussed. It was concluded that the NPS should undertake immediately, biological and ecological studies on the problems discussed.

Study Type:Summary review; Biological Component:Flora & fauna.

405. Tabb, D. C., T. R. Alexander, T. T. Thomas and N. Maynard. 1967. The physical, biological, and geological character of the area south of C-111 Canal in extreme southeastern Everglades National Park. Final Report for Contract 14-10-1-160-11 from NPS to Univ. of Miami (RSMAS), Miami, FL. 55 pp.

This study was conducted to determine if an un-restricted spill-over of saline water from the C-111 Canal in south Dade County onto the sawgrass habitat of eastern ENP would cause irreversible damage to the flora and fauna found there. Results indicate that freshwater soils, plants and animals make up about 50% of the total land area within the study area. The authors conclude that should a spill-over occur, there would be a southwestward spread of water, effecting periphyton and higher plants, resulting in the disappearance of freshwater fishes and invertebrates.

Study Period:February-March 1967, (Additional salinity measurements made on transects continuing into Florida Bay, 1964-1967, see Tabb and Roessler 1989,

reference no. 414 in bibliography); Study Type:Qualitative, quantitative; Gear Type:1-$m_2$ quadrats (vegetation), not given for animals; Number of Stations:82 (nine sited in the estuary); Habitat:marsh; Biological Component:Flora, fauna; Abiotic Parameters Measured:Salinity, sediment characteristics.

406. Tabb, D. C., B. Drummond and N. Kenny. 1974. Coastal marshes of southern Florida as habitat for fishes and effects of changes in water supply on these habitats. Rept. to USDI, Bur. of Sport Fish. & Wildl., Br. of River Basins, Contr. No. 14-16-0004-56. Univ. of Miami, RSMAS, Miami, FL. 63 pp.

In this report earlier studies conducted by the author are summarized. They point out a number of aspects of the marsh ecosystem in ENP which can be useful in managing Florida's coastal marshes. Studies on mangrove and black rush leaf and debris contributions to the aquatic system show that 14 species of marine gamefish utilize the marsh as opportunistic feeders. Species diversity is highest during the low water - high salinity period of late winter/early spring when marine species occupy the upper reaches of coastal rivers. Low dissolved oxygen limits the intrusion of fishes more strongly than either salinity or temperature. In addition, minimal levels of DO are found naturally in the impounded black mangrove forests. It was found that the most valuable attribute of the marsh is its food producing capability based mostly on the decay of plant material. The North River study area, in a near-natural state, differs from all the rest of coastal south Florida. Only in ENP is the sheet flow of fresh water across the marshes sufficient to carry marsh by-products and small animal populations seaward. It was concluded that ENP coastal marshes are part of a vast fresh water continuum with a marine phase intruding briefly during drought whereas, in most other areas of Florida, the marshes have been converted into a part of the marine system with short intrusions of fresh water influence.

Study Period:September 1965 through April 1967; Study Type:Qualitative; Habitat:Coastal marsh; Gear Type:Fyke nets, traps, rotenone, H & L; Number of Stations:8 biological/17 hydrological; Temporal Frequency:Monthly; Biological Component:Fishes; Abiotic Parameters Measured:Salinity, temperature, DO, tide level; Dominant Taxon/Taxa Studied:Sheepshead minnow, *Cyprinodon variegatus*.

407. Tabb, D. C., D. L. Dubrow and R. B. Manning. 1962. The ecology of northern Florida Bay and adjacent estuaries. Fla. St. Bd. Conserv. Tech. Ser. No.39, 81 pp.

This report presents the results of hydrographic studies (Part I) and the results of biological studies (Part II) conducted in northern Florida Bay and adjacent areas of ENP from July 1957 through May 1962. This area was selected for study because it represents an estuary largely protected from man's activities. Results will be used to better understand animal and plant distributions under naturally fluctuating environmental conditions, thereby assisting the evaluation of reclamation projects on the biota of similar regions along the Florida seacoast and elsewhere. It was found that Florida Bay was characterized by high turbidity, shallow waters, and dominant cover (*Thalassia*). Flora and fauna of the offshore regions were related to the major substratum types. A large influx of fishes and invertebrates into the study area in the late fall, corresponding to lower salinities,

was noted.An assessment of bottom sediments provided an estimate of the character of the bottom as a substratum for benthic organisms and gave an indication of the nature of deposition of the various sediment size fractions in relation to currents, wind transport, and fresh water source.

Study Period:Approximately 4 years; Study Type:Qualitative; Habitat:Offshore (basins, banks, channels), inshore (bays, rivers, channels); Gear Type:Otter trawl, bottom grab, fish toxicants, night-light dipnetting, nets (channel, push, seines); Number of Stations:40; Number of Replicates/Station:1; Temporal Frequency:Monthly; Abiotic Parameters Measured:Salinity, temperature, DO, pH, tides, transpiration, winds, water clarity; Dominant Taxon/Taxa Studied:*Thalassia, Chara, Halodule, Anomlocardia, Macoma, Brachiodontes, Cerithium, Periclimenes, Penaeus, Echinaster, Ophiophragmus, Anchoa* spp., *Lagodon, Bairdiella.*

408. Tabb, D. C., D. L. Dubrow and R. B. Manning. 1959. Hydrographic data from the inshore bays and estuaries of Everglades National Park, Florida. 1957-1959. Univ. of Miami, The Marine Lab., Miami, Florida. ML No.59253. 26 pp.

This report presents a summary of hydrographic data collected during the first 2 years of an ecological study (Tabb et al. 1962, no. 407 in bibliography) conducted in northern Florida Bay and adjacent estuaries, 1957-1959.

Study Period:1957-1959: Study Type:Qualitative; Habitat:Estuarine, coastal marine (bays, rivers, canal); Number of Stations:37; Temporal Frequency:Monthly; Abiotic Parameters Measured:Salinity, temperature, depth, DO, pH.

409. Tabb, D. C. and D. L. Dubrow. 1962. Hydrological Data. Supplement 1. From the inshore bays and estuaries of Everglades National Park, Florida 1959-1962. Fla. St. Brd. of Conserv. Rept. No. 62-9. 22 pp.

Hydrographic data collected during the final two years (1959-1962) of an ecological study (Tabb et al. 1962, no. 407 in bibliography) conducted in the inshore waters of northern Florida Bay and adjacent estuaries was presented.

Study Period:1959-1962; Study Type:Qualitative; Habitat:Estuarine, coastal marine (bays, rivers, canal); Number of Stations:31; Temporal Frequency:Monthly/diurnal; Abiotic Parameters Measured:Salinity, temperature, depth, DO, pH, tide.

410. Tabb, D. C., D. L. Dubrow and A. C. Jones. 1962. Studies on the biology of the pink shrimp, *Penaeus duorarum* Burkenroad, in Everglades National Park, Florida. Fla. St. Bd. Conserv. Tech. Ser. No. 37. 32 pp.

The biology of the pink shrimp of northern Florida Bay was studied in conjunction with other studies on the ecology of estuarine flora and fauna (see reference no. 407). Over 25,000 juveniles collected during the period September 1957, through April 1962, were examined for length and sex composition. Pink shrimp enter the estuary on flood tides, at night, as postlarvae, with a minimum of 1.7 mm CL; peaks of postlarvae abundance were found in the spring-early summer, low numbers in the fall and increasing numbers again beginning about November. A 1:1 M-F sex ratio was found among large samples of shrimp. Shrimp move to

deeper water during sudden cold temperatures of winter and with the warming of the shallows, move back unless they have reached the size for final emigration. CL frequency distributions reveal orderly progressions of modal groups along a similar pattern each year, followed by a sharp regression in size in June-July, indicating growth patterns and completion of offshore movement. A monthly 2-4 mm average CL increase was found. Most shrimp have moved out of the study area by 25 mm CL. Petersen tagging experiments indicated that mainland shrimp moved to the offshore Tortugas fishery. Pink shrimp are tolerant of wide ranges of salinity, but are less tolerant as they approach adult size. The effects of Hurricane Donna on estuarine shrimp populations, length-weight relationship, other penaeid shrimp and mortality were discussed.

Study Period:September 1957 through April 1962; Study Type:Qualitative, quantitative; Habitat:Canal, rivers, basin, bays; Gear Type:Dipnet, trawl, channel, wing and plankton net; Number of Stations:Variable (most samples were taken from 5 sites in the Buttonwood Canal, Joe and Shark River areas); Temporal Frequency:Monthly; Biological Component:Decapod crustacea; Abiotic Parameters Measured:Salinity, temperature, DO.

411. Tabb, D. C. and E. S. Iversen. 1971. A survey of the literature relating to the south Florida ecosystem. Part I. Univ. of Miami, RSMAS. Final Rept. ML71098. 205 pp.

This report provides an update of the literature which was compiled in Tabb 1963 (no. 404 in bibliography). The geographic area covered by this literature search is restricted to subtropical Florida south of a line drawn from Cape Kennedy to Tampa. A discussion of the extent of the literature coverage and a list of 1,909 references relevant to the environmental problems of the report area as determined by the authors were included. With the exception of shellfish, most references on coastal fishes and fisheries in the region are not included in this report but are found in Houde 1971 (no. 167).

Study Type:Qualitative, literature survey.

412. Tabb, D. C. and A. C. Jones. 1962. Effect of Hurricane Donna on the aquatic fauna of North Florida Bay. Trans. Am. Fish. Soc. 91(4):375-378.

In September 1960 Hurricane Donna caused heavy mortality among aquatic animals in north Florida Bay (ENP). Fish and invertebrates were stranded by retreating salt water which had been driven inland, or were killed by mud suffocation or turbulence. Oxygen depletion due to decomposition of organic material caused subsequent mortality. Salinities returned to normal within six weeks, but dissolved oxygen concentrations remained abnormally low for a longer period. Fish and invertebrates were scarce for several months in the areas of greatest oxygen depletion. Sportfish catches declined immediately after the storm, but recovered within one to three months. Juvenile pink shrimp moved from their estuarine nursery grounds to about 60 miles offshore. No aquatic fauna suffered permanent damage.

Study Period:September-December 1960; Study Type:Qualitative; Habitat:Estuarine; Biological Component:Fauna; Abiotic Parameters Measured:Salinity, DO, water temp.

413. Tabb, D. C. and R. B. Manning. 1961. A checklist of the flora and fauna of northern Florida Bay and adjacent brackish waters of the Florida Mainland collected during the period July 1957 through September 1960. Bull. Mar. Sci. Gulf and Caribb. 11(4):552-649.

Four hundred thirty two species of plants, invertebrate animals and fish are reported from the marine-brackish water areas of northern Florida Bay and adjacent estuaries in ENP. This paper presents notes on their abundance, tolerance to change in the physical environment, and distribution in relation to habitat in order to better understand their fluctuations in distribution and abundance in the natural environment. This information could eventually aid in interpreting changes in populations due to man-made alterations in shallow water.

Study Period:July 1957-October 1960; Study Type:Qualitative; Gear Type:Otter trawl, bottom grab, seines, H & L, fish toxicants, traps, night-light dipnetting, channel and pushnets; Number of Stations:12 hydrographic, 4 dipnetting, and 10 fish toxicant sites are shown on map, other sites are variable; Habitat:Offshore (Conchie Channel, Sandy Key Basin, Joe Kemp Channel), inshore (mangrove swamp, Coot Bay/ Whitewater Bay, Shark River); Abiotic Parameters Measured:Salinity, temperature; Biological Component:Flora, fauna: Dominant Taxon/Taxa Studied:*Udotea*, *Acetabularia*, *Thalassia*, *Echinaster*, *Brachiodontes*, *Cerithium* spp., *Modulus*, *Anomalocardia*, *Penaeus*, *Alpheus*, *Palaemonetes* spp., *Anchoa* spp., *Eucinostomus* spp., *Bairdiella*.

414. Tabb, D. C. and M. A. Roessler. 1989. History of studies on juvenile fishes of coastal waters of Everglades National Park. Bull. Mar. Sci. 44:23-34.

Knowledge of the species composition and general distribution of fishes in ENP coastal waters has a brief history beginning about 1957. Ten years later the list of fishes known to occur there, at least occasionally, had been lengthened to 167 species. Many of these occur in park waters only as juvenile stages; they apparently move offshore to mature spawn, and then re-enter park waters as waves of larvae, post-larvae, or early juveniles. It was not until the late 1960's and early 1970's that life histories and environmental "preferences" came under investigation. These studies, most of which were conducted in low-salinity waters, concluded that season and bottom vegetation were the chief determinants of juvenile fish occurrence and spatial distribution, and other factors such as salinity and temperature, had no statistically detectable influence on occurrence or abundance. However, studies of Florida Bay fish distribution and abundance during extended drought of the early and mid-1960's did suggest that salinities between 45 and 70 ppt were at least partly responsible for declines in both abundance and diversity, including both adult and juvenile stages. Previously unpublished information on fishes/invertebrates collected during the period 1964-66 from eastern Florida Bay to the Chatham River in the Ten Thousand Islands was also discussed.

Study Period:September 1964-February 1966; Study Type:Qualitative; Gear Type:Otter trawl; Temporal Frequency;Monthly; Number of Stations:8; Number of Replicates/Station:3; Habitat:Water column; Biological Component;Fishes/ invertebrates; Abiotic Parameters Measured:Salinity (Temperature and DO are among other parameters recorded but not presented in this paper); Dominant Taxon/Taxa Studied:Rainwater killifish, *Lucania parva*; mojarras, grunts, pinfish.

415. Taft, W. H. 1961. Authigenic dolomite in modern carbonate sediments along the southern coast of Florida. Science 134(3478):561-562.

Crystalline authigenic dolomite in shallow-water marine sediments from the margins of the North American continent is described for the first time. Dolomite is probably forming at the water-sediment interface along the western margin of Florida Bay (ENP) because of an interaction between organic material and hypersaline sea water.

Study Type:Quantitative;Habitat:Carbonate mud banks; Gear Types:Sediment cores; Abiotic Parameters Measured:Sediment characteristics.

416. Taft, W. H. 1963. Cation influence on the recrystallization of metastable carbonates, aragonites and high-magnesium calcite. Geol. Soc. Am. Spec. Pap. No. 73:252. (Abs.).

Unconsolidated carbonate sediments of Florida Bay (ENP), consist of more than 80% aragonite and high-magnesium calcite and show no evidence of recrystallization. Magnesium chloride solution and the magnesium in seawater appear to prevent recrystallization whereas chloride solutions of calcium and strontium, and water, cause recrystallization of aragonite and high-magnesium calcite at different rates. The Miami Oolite is used as a model to explain recrystallization of exposed Pleistocene metastable carbonates.-Adapted from author's abstract.

417. Taft, W. H. 1962. Dolomite in modern carbonate sediments, southern Florida. Am. Assoc. Petrol. Geol. Bull. 46(2):281. (Abs.)

The western margin of Florida Bay (ENP) contains extensive, shallow-water banks of unconsolidated, fine carbonate mud. The banks are separated by narrow tide channels, rest on Pleistocene bedrock, attain a thickness of 4 1/2 feet, and have been formed in the past 4,000 years. Dolomite may range up to 5% by weight of the total carbonate mud. The occurrence of rhombohedrons and intergrowths of organic and carbonate material suggests that dolomite has been formed *in situ* in Florida Bay, is older than 35,000 years and must be detrital.-Adapted from author's abstract.

418. Taft, W. H. 1962. Mineralogy of carbonate sediments along the western margin of Florida Bay, p. 676-677. (Abs.). IN Proc. 1st. Natl. Coas. & Shallow Water Res. Conf. 1961, Wash. DC. 897 pp.

This abstract presents a summary of research given in reference no's 415, 416, and 419.

419. Taft, W. H. 1962. Unconsolidated carbonate sediments of Florida Bay, Florida. Ph.D. Dissertation, Stanford Univ., Palo Alto, Calif. 60 pp.

In this report the chemical and mineralogical composition of modern unconsolidated carbonate sediments accumulating along the western margin of

Florida Bay (ENP) are described. The purpose of this study was to determine the possibility of using calcium, magnesium and strontium content of ancient limestones, as indicators of depositional environment. Systematic variations of Ca/Mg and Sr/Ca ratios, and percentages of carbonate minerals do not occur in these sediments as old as 3600 years. Rhombohedral dolomite and hexagonal prisms of low-magnesium calcite are report for the first time. Metastable aragonite and high-magnesium calcite together consititute approximatly 85% of the carbonate sediment. The metastable minerals exhibit no evidence of recrystallization and appear to be the most stable carbonates in this environment. Origin of aragonite and high-magnesium calcite is attributed to molluscs and foraminifera, whereas that of low-magnesium calcite and dolomite is not known.

Study Period:Jul-Aug 1959; Study Type:Qualitative, quantitative; Gear Type:Cores, tubes, hand; Number of Stations:12; Temporal Frequency:Once; Habitat:Mud; Biological Component:Molluscs; Abiotic Parameters Measured:Salinity, temperature, pH, sediment thickness, grain size.

420. Taft, W. H. and J. W. Harbaugh. 1964. Modern carbonate sediments of southern Florida, Bahamas, and Espirtu Santo Island, Baja, California: A comparison of their mineralogy and chemistry. Stanford Univ. Publ., Geol. Sci.8(2). 133 pp.

This report deals with a study of the mineralogy, chemistry, age relations, and origin of modern unconsolidated carbonate sediments that occur in shallow marine waters in (1) southern Florida including Florida Bay, Whitewater Bay/Lake Ingraham, and the Ten Thousand Islands in ENP (2) Andros Island and Yellow Bank, Bahamas, and (3) adjacent to Espirtu Santo Island, Baja, CA, Mexico. Variations in salinity, calcium, magnesium and chlorine content of interstitial water, pH of seawater and interstitial water, unconsolidated sediments (aragonite, calcite, & dolomite) in each of the three study areas of ENP are described.

Study Period:1959-1963 (In ENP-July, March 1959, April 1962); Study Type:Qualitative, quantitative; Gear Type:Hand, piston coring and metal snapper devices; Abiotic Parameters Measured:Temperature, pH, sediment depth, salinity, sediment characteristics; Habitat:Estuarine/coastal marine (open water bays, lakes, rivers in ENP); Number of Stations:Approx. 25 in Big Cypress estuary (Ten Thousand Islands), 22 in Whitewater Bay/Lake Ingrahm, 2 in Florida Bay.

421. Tanner, W. F. 1961. Mainland beach changes due to Hurricane Donna. J. Geophy. Res. 66(7):2265-2266.

On September 11-12, 1960, Hurricane Donna swept over lower southwest Florida. In June, detailed studies on wave energy were carried out in the Ten Thousand Islands, partially within the boundaries of ENP. Using prestorm and poststorm aerial photography (1953-1960) made from Cape Sable to Tampa Bay, comparisons were made which ascertained localized storm damage (sand movement). Based on prestorm and poststorm sand level differences of 5 feet, an annual transportation rate (past a given point), of $5 \times 10^4$ $m^3$ was calculated, indicating that Hurricane Donna had done 100 years of work in approximately 6 hours time. In addition, the author found no evidence of new beach ridges, suggesting that the storm-wave hypothesis for their construction must be questioned.

Study Period:1953-60; Study Type:Qualitative; Habitat:Beach.

422. Tanner, W. F., R. G. Evans and C. W. Holmes. 1963. Low-energy coast near Cape Romano, Florida. J. Sed. Petro. 33:713-722.

Studies in the Cape Romano-Ten Thousand Islands area (Pavillion Key in ENP northwestward to Cape Romano shoals) at the southern end of quartz sand littoral drift on the lower west coast, were used to examine wave energy, tidal circulation, and sediment characteristics. The shoreline in the study area was found to be one of low-to-moderate wave energy; where wave energy was very low and tidal energy important, particularly within park boundaries, a mangrove swamp barrier separates the lagoon from Gulf waters. Wave energy decreases toward the southeast. Sediments in the vicinity of Cape Romano are quartz sand and shell hash, whereas southeastward toward Pavillion Key, fine-grained sand, silt, clay, peaty material, and oyster bars comprise the mangrove-barrier-and-lagoon strip. Microfauna samples were separated four suites: marsh-river (mainland), lagoon, mangrove island, and open Gulf.

Study Period:June 1960; Study Type:Qualitative; Gear Type:Cores, field observations, air photo's; Habitat:Mangrove swamp, lagoon, shoreline, open Gulf waters;Abiotic Parameters Measured:Water depth & level, tidal flow, current direction, sediment characteristics.

423. Thayer, G. W. and A. J. Chester. 1989. Distribution and abundance of fishes among basin and channel habitats in Florida Bay. Bull. Mar. Sci. 44:200-219.

Surface and bottom trawls were used to sample fishes in basins and channels in the western half of Florida Bay (ENP). These data were evaluated in conjunction with information on environmental parameters, including seagrasses, to identify fish-habitat associations. Florida Bay is utilized by a diverse assemblage of fishes, dominated by juveniles and forage species. The western portion of their sampling area within Florida Bay, adjacent to Gulf waters, and channels within the Bay supported the highest diversity of fish. Channel areas were highest in standing crop and seagrass density. Basins in the western portion of the Bay were most diverse in terms of seagrass composition and exhibited the highest densities of *Syringodium filiforme*. Cluster analysis revealed two major station groups. One, characterized by fish species that occurred frequently and in large numbers, occurred in channels and in western Florida Bay where mixtures of seagrasses were prevalent; a second, characterized by low fish densities, occurred in monotypic stands of *Thalassia testudinum*. Discriminant function analysis demonstrated that comparatively higher sediment organic contents, slightly shallower water, and abundant *Halodule wrightii* and Syringodium populations were important factors at stations belonging to the typically high density fish cluster.

Study Period:May 1984-June 1985; Study Type:Quantitative; Habitat:Basins, channels; Biological Component:fishes, crustaceans, benthic flora; Gear Types:Trawls (bottom/surface); Number of Stations:202; Number of Replicates/ Station:One/trawl type (fish), three (vegetation), one to three (surface sediment); Temporal Frequency:9 monthly sampling visits; Abiotic Parameters Measured: Salinity, water temp. and depth, sediment organic content and thickness;

Dominant Taxon/Taxa Studied:Rainwater killifish (*Lucania parva*), silver jenny (*Eucinostomus gula*), pinfish (*Lagodon rhomboides*), Halfbeak (*Hyporamphus unfasciatus*).

424. Thayer, G. W., D. R. Colby and W. F.,Jr. Hettler. 1987. Utilization of the red mangrove prop root habitat by fishes in south Florida. Mar.Ecol. Prog. Ser. 35:25-38.

The inherent difficulty of sampling the red mangrove prop root habitat has impeded our understanding of the utilization of this habitat by fishes. During 1984-85, a block net and rotenone method was used to sample 2 sites in each of 4 estuarine/coastal marine regions in ENP (Florida/Whitewater Bays). At each site a 3 mm mesh net was used to enclose 3 sides of a mangrove stand while an onshore berm formed the fourth side. Samples collected from the mangrove prop root environment were compared with samples collected using a 2-boat otter trawl in the adjacent, fringing seagrass habitat. The density and biomass of fish collected by the two gear were greater in the prop root habitat than in the seagrass habitat. Also, there were consistent differences in species composition between the 2 habitat types across all 4 regions. Analysis of the stomach contents of gray snapper, *Lutjanus griseus*, suggested that smaller snapper tend to feed in the prop root habitat while larger snapper forage out into the adjacent areas to feed. This habitat is used by a wide variety of fish, and greater attention should be given to evaluating its contribution to fish production in south Florida and elsewhere.

Study Period:1984-85; Study Type:Quantitative, qualitative; Habitat:Coastal mangrove prop root, open water seagrass beds; Gear Type:Otter trawl, block net, rotenone; Number of Stations:8; Biological Component:Nonfishery spp/sportfish; Abiotic Parameters Measured;Salinity, temperature; Dominant Taxon/Taxa Studied:*Lutjanus griseus, Eucinostomus gula.*

425. Thayer, G. W., W. F.,Jr. Hettler, A. J. Chester, D. R. Colby and P. T. McElhaney. 1987. Distribution and abundance of fish communities among selected estuarine and marine habitats in Everglades National Park. Rept. SFRC-87/02. Homestead, Fla., Everglades N.P., South Florida Research Center. 166 pp.

The overall objective of this study was to evaluate relative species abundance and size composition of fish communities among selected habitats in estuarine and marine waters of ENP and to provide descriptions of the habitats in which these fishes occurred. Emphasis was placed on spotted seatrout (*Cynoscion nebulous*) and Gray snapper (*Lutjanus griseus*). Subobjectives included studies on juvenile fish associated with open water habitats and fish utilizing red mangrove prop root habitats. The study area was divided into five sampling strata that included Whitewater-Coot Bay, channels in Florida Bay, and three open water areas between eastern and western Florida Bay. Habitat and vegetative characteristics, and environmental conditions, are given for each sampling area. Western Florida Bay and channels in Florida Bay supported fish communities that were highest in fish density when compared to other areas. Cluster analysis demonstrated two major station groups occurring in channels and in northwestern Florida Bay. Juvenile gray snapper were most abundant in eastern Florida Bay while seatrout were collected mostly in the northwestern portion of the Bay. Data are also presented on the food habitats of these species and on the distribution of selected

crustaceans. Discriminant function analysis were employed to identify those environmental characteristics most important in determining snapper and seatrout habitat. It was concluded from the prop root study that red mangrove habitat is utilized by a wide variety of fish and that greater attention should be given to evaluating its contribution as a refuge and a source of food resources for fishes in ENP.

Study Period:May 1984-Sept 1985; Study Type:Qualitative, quantitative; Habitat:Open water (bay/basin), channel, red mangrove prop root;Biological Component:Fish (sportfish/nonfishery sp), crustaceans, benethic vegetation; Gear Type:Trawls (surface/bottom), 100 $cm^2$ quadrats; Number of Stations:Juvenile fish studies- 262, mangrove studies-16; Number of Replicates/Stations;Fish- 1 per trawl type, vegetation and sediment-1-3; Temporal Frequency:Monthly, irregular; Abiotic Parameters Measured:Salinity, water temperature and depth, sediment characteristics and thickness; Dominant Taxon/Taxa Studied:Silver jenny (*Eucinostomus gula*), pinfish (*Lagodon rhomboides*), rainwater killifish (*Lucania parva*), halfbeak (*Hyporhamphus unifasciatus*), hardhead catfish (*Arius felis*).

426. Thayer, G. W., W. F.,Jr. Hettler and D. W. Peters. 1985. Utilization of the red mangrove prop root habitat by fishes in South Florida. Estuaries 8(2B):104A. (Abs.).

Studies were conducted to describe the composition of fishes utilizing the fringing red mangrove prop root habitat of ENP and adjacent waters.Permanent stations were sampled for more than one year in Whitewater Bay, Coot Bay, and in Florida Bay adjacent to Flamingo and Plantation Key. Block nets and rotenone were used to sample the intertidal fringing habitat, and two-boat otter trawls were employed to sample the adjacent seagrass area to compare species composition. Stomach contents of some fish species from both habitats also were evaluated. The authors indicated that fringing red mangrove prop root habitat in ENP are utilized by juvenile and adult fish.-Adapted from authors' abstract.

427. Thayer, G. W., D. E. Ross and D. W. Peters. 1985. Habitat utilization by young-of-the-year fishes in the Everglades National Park. Estuaries 8(2B):33A. (Abs.).

The goal of this research is for ENP to understand the causes of variation in abundance and distribution of four species of fish (red drum, *Sciaenops ocellatus*; spotted seatrout, *Cynoscion nebulous*; snook, *Centropomus undecimalis*; and mangrove snapper, *Lutjanus griseus*) that are important to the sportfishery in ENP. The emphasis is on life history stages, habitats, ecological processes and environmental factors that are believed to be related to abundance. Major habitats being examined are (1) coastal spawning areas, (2) migration routes, (3), seagrass meadows, and (4) intertidal mangroves.-Adapted from authors' abstract.

428. Thomas, L. P. 1961. Distribution and salinity tolerance of the amphiurid brittlestar, *Ophiophragus filograneus* (Lyman, 1985). Bull. Mar. Sci. 11(1):158-160.

The distribution of the amphiurid, *Ophiophragus filograneus* in Florida was presented along with a brief discussion of the ecology of the species. Based on

collections of *O. filograneus* in Coot and Whitewater Bays, a new minimum salinity range (7.7 ppt) for echinoderms was reported.

Study Period:July-December 1958; Study Type:Qualitative; Habitat:Enclosed bays (mud/grassbeds); Biological Component:Ophiurid fauna; Number of Stations:Variable; Gear Type:Peterson grab/dip-net; Abiotic Parameters Measured:Salinity; Dominant Taxon/Taxa Studied:*Ophiophragmus filograneus*.

429. Thomas, L. P. 1962. The shallow water amphiurid brittle stars (Echinodermata, Ophiuridae) of Florida. Bull. Mar. Sci. Gulf & Caribb. 12(4):623-694.

The shallow water amphiurid brittle stars of Florida were described in detail. Specimens collected in ENP came from Coot and Whitewater Bays, and the Cape Sable-Flamingo region. A survey of the literature pertaining to tropical western Atlantic species was presented, along with a brief discussion of general biology and morphology. Nine genera and 21 species were reported, including illustrations and synonomies for each species. A large number of *Ophiophragmus filograneus* were taken from eastern Whitewater Bay. *Amphiodia trychna* and *Amphipholis pachybactera* H.L. Clark were recorded for the first time from Florida and the U.S.

Study Period:1958-1960; Study Type:Qualitative; Gear Type:Shovel; Number of Stations:9 sites (3 in ENP); Biological Component:Amphiuridae.

430. Thomas, L. P. 1959. A systematic study of the shallow water brittle stars of the family Amphiuridae of Florida. M.S. Thesis, Univ. of Miami., Miami, FL. 156 pp.

A systematic study of the biology and ecology of the Amphiuridae of South Florida was conducted. Collections from extreme south Florida included specimens from Coot and Whitewater Bays and the Cape Sable-Flamingo region. Keys to the genera and species and illustrations of all the species were provided.

Study Period:1958; Study Type:Qualitative; Gear Type:Shovel; Biological Component:Amphiurid fauna.

431. Thomas, T. T. 1970. A detailed analysis of climatological and hydrological records of south Florida with reference to man's influence upon ecosystem evolution. Final Rept. to the NPS, Contr. DI-NPS-14-10-1-160-18, from the Univ. of Miami, RSMAS, Miami, Fla. 89 pp.

The historical climatological records (1825-1968) of south Florida were summarized, based on rainfall and temperature records obtained from 157 stations in the region, and used to generate synoptic maps to display the geographical distribution of these two climatic variables. A minimum of seven years and as many as 15 years of data per station was required to obtain statistically valid monthly and annual averages. Using a single monthly time series record varying from 50 to 70 years in length, no long-term changes occurred when independently considering each month separately, however when considering linear records by month, by years a bi-annual component as well as one in the proximity of 5 years was found. In addition, changes in the elevation of the fresh water table and its relationship to saltwater encroachment and to estuarine and nearshore salinities

in ENP was studied using 80 hydrostations within the Florida-Whitewater Bay & Ten Thousand Islands region. In northern Florida Bay it was found that salinity changes were related to changes in the water table elevation and not to specific times of the year.

Study Period:Climatological records compiled from 1825-1968; Study Type:Quantitative; Number of Stations:157 (Rainfall/temperature); Abiotic Parameters Measured:Rainfall, temperature, salinity, water level.

432. Thue, E. B., E. S. Rutherford and D. G. Buker. 1983. Age, growth,and mortality of the common snook, *Centropomus undecimalis*, in Everglades National Park, Florida. Rept. T-683. Homestead, Fla., Everglades N.P., South Florida Research Center. 33 pp.

This study focused on the age, growth and mortality of snook, *Centropomus undecimalis*, collected from sportfishermen in ENP from May 1976 through December 1979. Three hundred twenty-five fish ranged in length from 284-940 mm FL and in weight from 0.7 - 11.6 kg. Mean lengths of fish were largest in spring and smallest in winter. There were no differences in mean length among areas of capture. Annulus formation occurred in spring (March-May). Ages of fish were mainly 4-5 year-olds. Recruitment to the fishery began at age 2 and was completed at age 6. The overall sex ratio favored males 3/1 and there were no differences in mean age of fish among areas of capture. Mean calculated growth of all snook was 375 mm FL in the fist year and 57-90 mm thereafter. Calculated fish lengths at age differed among areas and sexual differences in length-weight relationship were noted. Annual mortality rate of all fully recruited fish was 78%. Sexual differences in mortality rates were discussed.

Study Period:May 1976-December 1979; Study Type:Quantitative; Habitat: Estuarine/coastal marine; Biological Component:Sportfish; Gear Type:H & L; Dominant Taxon/Taxa Studied:*Centropomus undecimalis*.

433. Tilmant, J. T. 1989. A history and an overview of recent trends in the fisheries of Florida Bay. Bull. Mar. Sci. 44:3-22.

This paper presents a historical review and description of the fisheries of Florida Bay (ENP). Prior to the 1940's fishing activities were largely subsistence oriented, providing only supplemental family income. The first directed fishery was for striped mullet which provided the primary economic support of the historic Flamingo fishing village in the 1920's. Increased development of south Florida led to increased sportfishing activities during the 1940's and 1950's, which increased the development of the commercial silver mullet and live shrimp bait fisheries. By the 1970's , there were an estimated 25,000 recreational trips a year to Florida Bay. Commercial activities reached a peak between 1977-78. Concern for the conservation of Florida Bays's marine resources quickly followed the explosion of fishing activities occurring in the 1940's as Florida Bay was added to ENP in 1950 and, in 1951 regulations were enacted to control the methods, species, and locations of fish harvest. No accurate catch and harvest data were collected until

1958. Up to the present time the NPS monitoring program has provided harvest and effort data of both commercial and recreational fisheries. Five species (gray snapper, spotted seatrout, red drum, sheepshead and black drum) have comprised over 86% of the sportfish harvest since 1958.

Study Type:Fisheries review.

434. Tilmant, J. T., E. S. Rutherford and E. B. Thue. 1989. Fishery harvest and population dynamics of red drum (*Sciaenops ocellatus*) from Florida Bay and adjacent waters. Bull. Mar. Sci. 44:126-138.

A fisheries harvest monitoring program has provided catch and effort data on the harvest of red drum from Florida Bay since 1958 and lengths have been measured since 1974. The annual estimated total harvest from Florida Bay declined from 1973 to 1978, but increased dramatically in 1984. Although fishing effort has continued to increase since 1984, total reported catch of red drum has seriously declined. The red drum fishery is comprised of newly recruited fish. Prior to a 18-inch minimum size limit imposed in 1985, 51% of the annual harvest were 1-year-old fish, 38% were 2-year-olds, and less than 121% were 3 years or older. A virtual population assessment suggests that the park's fishable population of red drum declined from around 120,000 fish in 1974 to a low of 90,000 in 1977, but then increased to over 180,000 by 1980. Recent declines within the red drum population are not likely due to fisherman harvest unless such harvest has impacted offshore breeding stocks. Increased recruitment to the fishery followed high rainfall years, suggesting improved recruitment and/or survival of early stage juveniles during periods of increased upland runoff.

Study Period:1958-1985; Study Type:Quantitative; Gear Type:Dockside interview, field observations; Biological Component:Sportfish; Dominant Taxon/Taxa Studied:*Sciaenops ocellatus*.

435. Tilmant, J. T., E. S. Rutherford and E. B. Thue. 1989. Fishery harvest and population dynamics of the common snook, (*Centropomus undecimalis*) from Florida Bay and adjacent waters. Bull. Mar. Sci. (Abstract). 44:523.

The fishery harvest monitoring program of ENP has provided a record of the recreational snook fishery catch and effort from 1958 to present. Length data are available on harvested fish since 1974. Although this species has comprised less than one percent of the fishery harvest, it has been sought by as many 15 percent of the total fishing boats during a given year. A marked decline, noted in the annual number of boats successfully catching snook from 1974 to 1984, was due to a decline in the percent of boats successful for this species and the total number of boats within the park. Since 1982 an annual increase in the number of boats reporting snook catches has increased. The size distribution of fish harvested during 1983-84 suggests a recruitment of large numbers of young fish occurred those years. A discussion of an increase in annual harvest is presented. The data obtained indicate that bag limits, minimum size limits, and closed seasons have not resulted in a reduced annual harvest, however this may be due to unusually good recruitment years in 1983-84 as a result of the preceding high rainfall years in 1982-83 which may enhance larval and/or juvenile snook survival by increased upland runoff or marsh flooding.-Adapted from authors' abstract.

436. Tilmant, J. T., E. S. Rutherford, R. H. Dawson and E. B. Thue. 1990. Impacts of gamefish harvest in Everglades National Park. Pgs. 75-103 In: G. Larson & M. Soukup (Eds). Vol 6. Proc. Conf. Sci. Nat'l Pks., Washington, D.C.

The estuarine fisheries monitoring program of ENP provided a 24 year record of stock response to fishing effort, harvest, and environmental conditions. Over 80 species of fish were reported within recreational and commercial catches; however, only five species comprised over 86% of the gamefish harvest. Harvest of the three top gamefish, gray snapper, *Lutjanus griseus*, seatrout, *Cynosion nebulous*, and red drum, *Sciaenops ocellatus* has approached maximum sustainable yield (MSY in number) over the past 12 years. Recent bag and size limits have reduced harvest, but the popularity of red drum has increased and its harvest may now exceed MSY. Estimated fishing mortality rates (F) have averaged 0.36 for seatrout, 0.78 for gray snapper, and 1.45 for red drum. An overall decrease in fish stocks was noted during the mid-1970's and may have been the result of low rainfall and reduced estuary runoff resulting in increased natural mortality and reduced recruitment rather than harvest. High rainfall was correlated with increased stock abundance during recent years.

Study Period:1958-1984; Study Type:Quantitative; Habitat:Estuarine/coastal marine; Gear Types:H & L, nets; Biological Component:Sportfish, commercial finfish; Dominant Taxon/Taxa Studied:Seatrout, red drum, gray snapper, snook, mullet.

437. Tisserand, D. L. 1979. Foraminiferes de deux localities de la Floride et des environs: Joe Kemp Key et Key Biscayne (Foraminifera from two localities in Florida and vicinity: Joe Kemp Key and Key Biscayne). Univ. Geneve, Lab. Paleontol., Geneva. Notes du Laboratorie de Paleontologie 4(1-6):19-25 (In French).

No abstract available.

438. Turney, W. J. and B. F. Perkins. 1972. Molluscan distribution in Florida Bay. Sedimenta III. Compar. Sedimen. Lab., Univ. Miami, Miami, Fl. 37 p.

On the basis of the physical characteristics of salinity, water circulation, and wind described in this report, four sub-environments in Florida bay (ENP) can be recognized: (1) the Northern Sub-environment, (2) the Interior Sub-environment, (3) the Atlantic Sub-environment, and (4) the Gulf Sub-environment. The fauna of Florida Bay is dominantly molluscan, principally gastropods and bivalves which are represented by approximately 100 genera and 140 recognized species. A few "index species" and several "consistently common species" define four molluscan suites whose distributions appear to be controlled by the environmental influences characterizing the four sub-environments. Molluscan debris comprises 58 to 95% of the sediment particles greater than 1/8 mm. It is believed that the disintegration process is almost entirely organic and effected by crabs, boring sponges, perforating algae, holourthians, worms, and *Thalassia* roots. Thin-shelled bivalves tend to break down more rapidly than thick-shelled bivalves and gastropods.

Study Period:1953-1958; Study Type:Qualitative; Gear Type:Cores, jars; Number of Stations:Bay-wide (variable); Habitat:Sub-surface sediment; Biological

Component:Mollusks; Dominant Taxon/Taxa Studied: Bivalves/gastropods (*Anomalocardia cuniemeris, Brachidontes exustus, Pinctada radiata, Cerithium muscarum, Bittium varium, Codakia orbicularis, Astrea longispina, Nucla proxima*).

439. Tyson, R. 1981. Sediments of a Florida Bay basin. M.S. Thesis, Univ. of South Florida. Tampa.

In a southeastern Florida Bay basin (ENP), 44 surface sediment samples exhibited variations in texture, mineralogy, and molluscan assemblages. Sediment grain size analysis separated the samples into three major groups. Aragonite averaged approximately 51% in the silt and clay sized fractions. Bivalves were shown to prefer small grain sized sediments. A direct correlation between bivalve and *Thalassia* distribution was associated with the trapping of fine grained sediments by seagrass beds. Epifaunal gastropods exhibited uniform distribution. Correlations among sand, depth, rock fragments, foraminifera, *Cerithium*, *Halimeda*, and calcite content are identified for sand environments; correlations among other variables are also cited for silt environments.

Study Type:Quantitative; Habitat:Mud, sand; Biological Component:Flora and fauna; Gear Type:Hand core, pipe dredge; Abiotic Parameters Measured:Sediment grain size, mineral content; Dominant Taxon/Taxa Studied:*Thalassia, Halimeda, Cerithum, Pseudocyreba.*

440. Ullman, W. J. and R. C. Aller. 1982. Diffusion coefficients in nearshore marine sediments. Limmnol. Oceanogr. 27(3):552-556.

The formation resistivity factor, F, necessary to calculate bulk sediment diffusion coefficients of interstitial solutes from free solution diffusion coefficients, can be estimated from sediment porosity. These results are based on, in part, from core samples taken on Captain Key Bank in Florida Bay (ENP).

Study Type:Quantitative; Habitat:Mud bank; Gear Type:Cores.

441. Ullman, W. J. and R. C. Aller. 1985. The geochemistry of iodine in near-shore carbonate sediments. Geochim. Cosmochim. Acta 49(4):967-978.

The geochemistry of iodine was investigated using carbonate sediment samples from Captain Key Bank in Florida Bay, ENP.

Study Type:Quantitative; Habitat:Mud bank; Gear Type:Cores.

442. Van Arman, J. 1984. South Florida's estuaries, Pages 79-96 IN P.L. Gleason, ed. Environments of south Florida, present and past II, Miami Geol. Soc., 2nd ed., 551 pp.

In this article 12 major estuarine areas of south Florida are identified. A physical description, summary of research, discussion of problems, and survey of current management studies are presented for each estuary including ENP. A list of references for the region and for each estuary is provided. These studies and the

level of current interest indicate that major efforts are underway to analyze and resolve the problems of south Florida's estuaries, resulting in a substantial increase in our knowledge and our ability to manage these systems.

Study Type:Qualitative, environmental review.

443. Vaughan, T. W. 1910. A contribution to the geological history of peninsular Florida. Carnegie Inst. Publ. 133. Vol. 4.

In this study the bottom sediments from samples collected behind the keys from Miami to Key West are described for the first time. Although the scope of this paper was originally designed to study the deposits accumulating behind the keys, it was enlarged to trace the geologic history of the Floridian Plateau. Of 47 sites sampled, 6 were located within or adjacent to the eastern boundary of ENP in Florida Bay including Blackwater Sound, Pigeon Key and the Tavernier Creek area. The marine deposits were described as inorganic (chemically dissolved $CaCo_3$) and organic (from mollusks and foraminiferans). As sand becomes rarer toward the southwest, calcium carbonate becomes progressively more abundant, occurring as a flocculent sediment over practically the entire region.

Study Period:April 1908; Study Type:Qualitative; Habitat:Shallow open water bays, sounds, creeks (ENP); Number of Stations:47 (6 in ENP); Abiotic Parameters Measured:Water depth, percent sediment characteristics.

444. Videlock, S. L. 1983. The stratigraphy and sedimentation of Cluett Key, Florida Bay. M.S. Thesis, Univ. of Conn., Storrs. 172 pp.

This study examines the stratigraphy and sedimentation of Cluett Key, a carbonate mud island located on Dildo Bank in the center of Florida Bay (ENP). Florida Bay is an important area for the study of Holocene carbonate mud; the mud accumulates in several different environments each having different characteristics. Three lithologies of Cluett Key are described: 1) peat, 2) subtidal sediments, 3) supratidal sediments. Contacts between the supratidal sediment and the subtidal sediment suggest that Cluett Key may still be growing in a east-southeast direction. Based on the amounts of dolomite found in island cores (up to 41% of the carbonate fraction) and the insignificant amounts (<3%) found in the adjacent mudbanks, suggests that the formation of dolomite may be related to island controlled processes.

Study Period:Two weeks (July 1976); Study Type:Qualitative; Habitat:mud; Biological Component:Fauna; Number of Stations:Topo map (6 base sites), Sediments (approx. 20 sites with 25 cores), several wellfield sites; Gear Types:Mapping (transit/stadia rod), sediments (piston corer), wellfields (PVC pipes), probes, tidal gauges; Abiotic Parameters Measured:Sediment characteristics, salinity, alkalinity, pH, cations, tide level, bedrock depth.

445. Volpe, A. V. 1959. Aspects of the biology of the common snook, *Centropomus undecimalis* (Bloch) of southwest Florida. Fla. St. Bd. Conserv. Tech. Ser. No. 31. 30 pp.

Narrative same as in reference no. 446.

446. Volpe, A. V. 1959. Aspects of the biology of the common snook, *Centropomus undecimalis* (Bloch) of southwest Florida. M.S. Thesis, Univ. of Miami, Miami, Fla. 72 pp.

Aspects of migrations, age and growth of the common snook were examined in the estuarine and coastal marine waters of Florida. In ENP, collections were made in the Chokoloskee Bay area. Using various types of tags and recapture methods, a total of 2,068 fish were tagged, with a recapture rate of 2.9%. The snook was found to be a nonmigratory, relatively fast-growing fish, spawning large number of eggs (a ripe 584 mm fish contained 1,440,000 ova) in saline passes during late spring and early summer. These fish reach an age of 7 years.

Study Period:1955-1957; Study Type:Quantitative, qualitative; Habitat:Estuarine/coastal marine (passes,beaches, rivers, inland bays); Gear Type:Beach seine, H & L; Biological ComponenT:Sport & commercial fish; Dominant Taxon/Taxa Studied:Common snook.

447. Wade, R. A. 1962. The biology of the Tarpon, *Megalops atlanticus* and the ox-eye, *Megalops cyprinoides*, with emphasis on larval development. Bull. Mar. Sci. Gulf and Caribb. 12:545-622.

Narrative same as in reference no. 448.

448. Wade, R. A. 1962. The tarpon, *Megalops atlanticus*, and the ox-eye, *Megalops cyprinioides*, emphasizing larval development. M.S. Thesis, Univ. of Miami, Miami, Fla. 168 pp.

This report briefly describes the distribution of the genus *Megalops* in the Atlantic, Pacific, and Indian Oceans as well as materials and methods of collections used in the study of larval and juvenile specimens from various cruises and miscellaneous collections. Information is provided on the early development stages of both species including indices and graphs of gross morphological changes during development. The geographical distribution of the material studied and records from the literature are presented. Collections of tarpon in ENP were concentrated in the Coot Bay area. Occurrence of the larval material studied suggests that both species spawn in offshore waters nearly paralleling the range of the adults. Habitat, behavior, relationship to salinity, temperature, sportfishing qualities, and economic values are discussed.

Study Period:Collections were made from 1920-1960; Study Type:Quantitative, qualitative; Habitat:Inshore/offshore; Gear Type:Plankton nets, rotenone; Number of Stations:Variable; Biological Component:Sportfish; Abiotic Parameters Measured:Salinity, temperature; Dominant Taxon/Taxa Studied:*Megalops atlantica*, *M. cyprinoides*.

449. Waldinger, F. J. 1968. Relationships of environmental parameters and catch of three species of the mojarra family (Gerridae), *Eucinostomus gula*, *Eucinostomus argenteus*, and *Diapterus plumieri*, collected in 1963 and 1964 in Buttonwood Canal, Everglades National Park, Florida. M.S. Thesis, Univ. of Miami, Miami, Fla. 68 pp.

Mojarras, an abundant constituent of the fish fauna in the Buttonwood Canal, were investigated to determine the relationship between their catches and environmental parameters. Physical/chemical/biological factors studied included salinity, temperature, water depth, current speed, ground water level, rainfall, month of the year, moon phase and numbers of fish themselves. Relationships usually were not obvious; *E. argenteus* favors high salinity with catches best related to salinity and rainfall; *E. gula* is a euryhaline, estuarine species with catches best related to ground water level & rainfall; *D. plumieri* favors brackish to freshwater conditions with catches best related to water level, moon phase, and temperature. Future recommendations included log transformations of the catch data, elimination of highly interdependent environmental parameters, and examination of the spawning and migration activities of these fishes.

Study Period:January 1963-January 1965; Study Type:Quantitative; Number of Stations:1; Temporal Frequency:2 consecutive nights semi-monthly; Gear Type:Channel net; Habitat:Canal (water column); Biological Component:Nonfishery sp.; Abiotic Parameters Measured:Salinity, temperature, water level, rainfall, water depth, moon phase, current speed; Dominant Taxon/Taxa Studied:*E. gula*, *E. argenteus*, *D. plumieri*.

450. Walker, N. D. 1981. January water temperatures kill Florida fauna. Coast. Oceanogr. Climatol. News. 3(3):30.

Seven cold fronts reached southern Florida during Jan. 1981, depressing air and water temperatures below normal for most of the month. Intense frontal systems moved into the area Jan 10 and 16, causing air temperature minima over Florida Bay of 2.2 and 5.3°C, respectively, and wind speeds in excess of 15 m/sec at Key West. Florida Bay water reached temperatures of 9.0°C. The effects of the Jan. 16 frontal passage on shallow bank and bay environments (ENP) is shown on a NOAA-6 satellite image.-Adapted from an abstract obtained from D. Deis, CSA.

451. Walker, N. D. 1982. Physical responses of southern Florida and northern Bahama lagoon waters to severe cold air outbreaks and effects on hermatypic coral reefs. M.S. Thesis, Louisiana State Univ., Baton Rouge, La. 114 pp.

Major mortalities of souther Florida and northern Bahama reef corals during recent winters suggest that chilled water masses may influence their development. This research was undertaken to investigate the regional extent, duration, and frequency of water mass chilling and preferential routes for offshore water movement. Temperature infrared satellite data (NOAA-5 & NOAA-6), *in situ* water temperatures from eastern Florida Bay, ENP, local meteorological data, and a numerical heat flux model were incorporated in the analyses. Study results indicated that souther Florida and northern Bahama lagoons provide less than optical environmental conditions during winter for reef growth and development. Shallow bays of southern Florida chill below the 16°C thermal stress threshold for

reef corals several times each winter. The longest observed residence time for sub-16°C water in Florida Bay was 12 days during January 1981. The present distribution of reef corals can be attributed to cold air outbreak chilling of shallow lagoon waters and their offshelf transport routes.

Study Period:1976-77, 1979-81; Study Type:Quantitative; Gear Type:Satellite data, thermographs, tide gauges, meteorological sensors; Number of Stations:Southern Florida - One water temperature station in Florida Bay (ENP), other sites from Tavernier to Key West; Habitat:Water column; Abiotic Parameters Measured:Air & water temperature, wind speed & direction, tides, air pressure, dew point temperature, solar radiation, cloud cover.

452. Walker, N. D., H. H. Roberts, L. J.,Jr. Rouse and O. K. Huh. 1982. Thermal history of reef-associated environments during a record cold-air outbreak event. Coral Reefs 1(2):83-87.

Several polar continental air masses intruding into the south Florida/northern Bahama Bank region during Jan. 1981 caused record low air temperatures and rapid chilling of extensive shallow-water carbonate systems. Numerous "coral kills" along the Florida reef tract and massive fish mortalities in Florida Bay (ENP) were attributed to unusually cold waters generated at this time. Thermal evolution of Florida Bay/Florida reef tract and northern Bahama Bank waters from 8 to 21 Jan. was assessed from thermal infrared data acquired by the NOAA-6 environmental satellite, in situ water temperatures, local meteorological data, and a computerized heat flux model. Offshore movement of bay water is driven primarily by strong northerly winds, density gradients, and tidal pumping. Absence of reef development opposite major tidal passes along the reef tract and aperiodic coral kills along bank margins can be attributed to this process, which has probably had a limiting influence on Holocene reef development in these areas.-Adapted from an abstract obtained from D. Deis, CSA.

453. Wallis, O. L. 1959. Research and interpretation of marine areas of the U.S. National Park Service. Proc. Gulf Caribb. Fish. Inst. 11:134-138.

This paper reviews current management practices and research activities in marine areas of the NPS as part of Mission 66, a ten year program to develop and fulfil future research and interpretive requirements. Research activities discussed, pertinent to the coastal marine and estuarine areas of ENP include marine fisheries studies and ecological studies in Florida Bay and other coastal brackish waters.

Study Type:Qualitative, ecological review.

454. Wanless, H. R. 1974. Mangrove sedimentation in geological perspective. Pages 190-200, IN P.J. Gleason, ed., Environments of south Florida: Present and Past. Miami Geol. Soc. Mem. 2. 452 pp.

Coastal mangrove swamps are a passive sedimentary environment, offering some resistance to erosion, in which peat accumulates predominate if the area is protected from strong physical agitation and detrital sediment influx. Coastal swamps have produced transgressive, regressive, oscillating and equilibrium

(non-migrating) accumulates on the south Florida (including coastal areas of ENP) and Bahama Platforms during the post-glacial, Holocene, sea-level rise. The varied patterns of coastal swamp sedimentation were related to the complex, preexisting and evolving co-existing topography through its influence on wave and current pattern, detrital sediment influx and freshwater drainage. Physical and chemical attributes of mangrove swamps can strongly influence the character of adjacent sedimentary environments.

Study Type:Qualitative, geologic review.

455. Wanless, H. R. 1979. Role of physical sedimentation in carbonate-bank growth. Am. Assoc. Petrol. Geol. Bull. 63(3):547. (Abs.).

Carbonate mud banks of central Florida Bay (ENP) contain three types of sediment wedges which provide evidence that pulses of rapid physical sedimentation are a dominant cause for bank growth. Most dramatic are layered to laminated wedges of carbonate mudstone flanking eastern, southern, or western bank margins. Three features suggest rapid deposition: vertical escape burrows extending upwards from the basal sand, vertical water escape fractures in the lower part, and abundant seagrass blades incorporated into the layers. The second wedge is similar to that described above, while the third wedge is a biotubated, soft pellet wackstone, containing seagrass rhizomes throughout. The layered wedges provide a record of rapid subtidal sedimentation during hurricanes.-Adapted from author's abstract.

456. Wanless, H. R. 1978. Storm generated stratigraphy of carbonate mud banks, South Florida. Geol. Soc. Am., Abstr. Prog. 10(7):512.

Southward migration and expansion of east-west trending carbonate mud banks within Biscayne and Florida Bay (ENP) have generated sedimentary sequences composed of four lithologies. These lithologies, produced by an interaction of hurricane and repetitive winter storm sedimentation, record a dynamic history of physical sedimentation caused by accretion and erosion during minor and major storm events and probably also by evolving stability of subcircular bay patterns during late stages of the Holocene rise of sea level.-Adapted from author's abstract.

457. Wanless, H. R. and M. G. Tagett. 1989. Origin, growth, and evolution of carbonate mudbanks in Florida Bay. Bull. Mar. Sci. 44:454-489.

During the sea level rise of 4,500 to 3,000 years Before Present which inundated the Florida Bay (ENP) area, coastal and freshwater peat and shore levee deposits were repeatedly embayed and overstepped. These deposits served as nuclei from which the present complex of Florida Bay island, mudbanks, bank spits, and bays evolved. Marine mudbanks nucleated on inundated coastal levees and mangrove peats. Striking lateral gradation in bank morphology and internal stratigraphy reflect gradients in sediment supply, physical processes and biogenic communities during later Holocene flooding history. Four zones were recognized: (1) Inner Destructional Zone in eastern Florida Bay, (2) Central Migration Zone in the central portion of the Bay, (3) Western Constructional zone in western Florida Bay, and (4) Outer Destructional Zone along the exposed western margin of the Bay. The

destructional impact of intensive marine burrowing on sedimentation was noted. Although seagrasses are a dominant community in Florida Bay at present, the authors' indicate that (a) seagrasses are now at a peak in their influence in Florida Bay, (b) they are episodically eliminated from much of the Bay, and (c) seagrasses have had only a minor to moderate influence on the growth and evolution of Florida Bay's mudbanks.

Study Type:Qualitative, quantitative; Habitat:Mudbanks, bedrock; Gear Types:Aerial photography (1935 to present), cores; Number of Stations:Eight banks (eastern Florida Bay - 65 cores), one bank in western Florida Bay -(161 cores, 451 probes to bedrock);Abiotic Parameters Measured:Sediment characteristics and thickness.

458. Wickham, D. A. 1967. Observations on the activity patterns in juveniles of the pink shrimp, *Penaeus duorarum*. Bull. Mar. Sci. 17(4):769-786.

Laboratory observations of diel patterns in locomotor and burrowing activity of juvenile *Penaeus duorarum* taken from Buttonwood Canal (ENP) were made under constant light intensity, water current, and water level. Activity patterns appeared to be regulated by tidal and lunar perodicities. Experimental variation of light and water levels also affected behavior patterns of juvenile pink shrimp. Activity patterns of *Penaeus* in the field were concluded to be determined by an interaction of ambient environmental stimuli and rhythmic patterns of abiotic parameters.

Study Type:Quantitative; Biological Component:Decapod crustacea; Abiotic Parameters Measured:Salinity, temperature, DO; Dominant Taxon/Taxa Studied:*Penaeus duorarum*.

459. Wilson, K. A. 1989. Ecology of mangrove crabs: predation, physical factors and refuges. Bull. Mar. Sci. 44:263-273.

This study established the relative importance and interactions of biological and physical factors as influences on microhabitat utilization of crabs in mangrove forests in Florida Bay (ENP). The four species of mangrove crab investigated include *Aratus pisonii* an arboral crab: *Eurytium limosum*, *Sesarma curacaoense*, and *Uca thayeri* live in burrows and holes on the mud surface. Field predation tethering experiments found a differential risk of predation among microhabitats and strong tidal and seasonal differences in predation rates. Species exhibited different responses to temperature and relative humidity in each microhabitat. Mangroves provide structural refuge from predation for crabs. It was determined that crabs must balance the constraints of physiological tolerances and the avoidance of predation in a system that has a seasonally variable risk of predation and environmental conditions.

Study Period:1982-1984; Study Type:Quantitative; Habitat:Tidal mangrove forest, mud flats; Number of Stations:3; Gear Type:Fishing line, glue; Biological Component:Brachyuran crabs; Abiotic Parameters Measured:Air temp., relative humidity; Dominant Taxon/Taxa Studied:*Eurytium limosum*, *Aratus pisionii*, *Sesarma curacaoense*, *Uca thayeri*.

460. Wilson, K. A. 1985. Physical and biological interactions that influence habitat use of mangrove crabs. Ph.D. Dissertation, Univ. of Pennsylvania, Philadelphia, PA. 167 pp.

This study examines the relative importance of biological and physical factors in the microhabitat use and distribution of four species of crabs in mangrove forests in south Florida including the Florida Bay portion of ENP. Three aspects were investigated: 1) Estimation of risk of predation among microhabitats in the mangrove; 2) Evaluations of competitive interactions for refuges; 3) Definition of suitable physiological microhabitats and measurements of responses to exposure in microhabitats in the field. The four species of mangrove crabs, *Aratus pisonii*, *Eurytium limosum*, *Sesarma curacaoense*, and *Uca thayeri* broadly overlap in habitat use and share periodic shifts in microhabitat locations. Field experiments show a differential risk of predation among microhabitats by tide levels and show that a change in predation intensity and predator type results in strong tidal and seasonal components of refuges. Crabs must balance the constraints of physiological tolerances with the avoidance of predation. No single physiological factor can be labeled as the cause of distributional patterns.

Study Period:1982-1984; Study Type:Quantitative; Habitat:Tidal mangrove forest, mud flats; Gear Type:Fishing line, glue; Number of Stations:3; Biological Component:Brachyuran crabs; Dominant Taxon/Taxa Studied:*Aratus pisonii*, *Eurytium limosum*, *S. curacaoense*, *U. thayeri*; Abiotic Parameters Measured:Air temp., relative humidity.

461. Windom, H. L., S. J. Schroop, F. D. Calder, J. D. Ryan, R. G., Jr. Smith, L. G. Burney, F. G., III Lewis and C. W. Rawlinson. 1989. Natural trace metal concentrations in estuarine and coastal marine sediments of the southeastern United States. Environ. Sci. Technol. 23:314-320.

Over 450 sediment samples from estuarine and coastal marine areas of the southeastern United States remote from contaminant sources were analyzed for trace metals. In ENP samples were collected in the Ten Thousand Islands (Big Cypress estuary), Whitewater, and Florida Bays. Although these sediments are compositionally diverse, As, Co, Cr, Cu, Fe, Pb, Mn, Ni, and Zn concentrations covary significantly with aluminum, suggesting that natural aluminuosilicate minerals are the dominant natural metal bearing phases. Cd and Hg do not covary with aluminum. It is suggested that the covariance of metals with aluminum provides a useful basis for identification and comparison of anthropogenic inputs to southeastern U.S. coastal/estuarine sediments. By the use of this approach sediments from the Savannah River, Biscayne Bay, Pensacola Bay are compared.

Study Type:Quantitative; Habitat:Estuarine/coastal marine sediments; Number of Stations:103 in Florida; Gear Type:Ponar grab; Abiotic Parameters Measured:As, Cr, Cu, Fe, Pb, Mn, Ni, Zn.

462. Woelkerling, W. J. 1976. South Florida benthic marine algae. Sedimenta V. The Compara. Sed. Lab., Div. of Mar Geol. & Geophys., Univ of Miami, Miami, FL.

This paper provides illustrated keys to the genera of green, brown, and red algae and to the genera and species of blue-green algae commonly found in marine

benthic communities of Florida with emphasis on those forms found in the Florida Bay portion of ENP. A glossary of morphological terms used in the keys, the literature pertaining to Florida marine algae, brief comments on marine algae habitats and communities and instructions for the collection, preservation, and examination of algae material were included.

Study Type:Review, qualitative: Biological Component:Benthic flora.

463. Woodroffe, C. D. 1981. Mangrove swamp stratigraphy and Holocene transgression, Grand Cayman Island, West Indies. Mar. Geol. 41(3/4):271-294.

The transgressive sedimentary sequence on Grand Cayman is similar to transgressive sedimentary sequences described from the Florida Everglades-mangrove complex, Florida Bay (ENP), and the Belize Shelf. A summary review table of mangrove peat data collected from various sites in ENP estuarine and coastal marine waters is presented.

Study Type:Quantitative, qualitative with review of peat data collected in ENP; Biological Component:Mangrove peat; Habitat:Coastal mangrove swamp.

464. Yokel, B. J. 1966. A contribution to the biology and distribution of the red drum, *Scianops ocellata*. M.S. Thesis, Univ. of Miami, Miami, Fla. 160 pp.

Most of this research was done in the estuarine and coastal marine waters of ENP. Red drum are one of the three most sought after species in the sport fishery of the Park. This thesis also includes a general study of the fishery and biology of the species over its entire range. Gulf coast populations are stable but a decline has occurred on the east coast since 1935. Abundance of red drum is positively correlated with estuarine area. It is most abundant at the southern part of its range. Its relative abundance is great in the Gulf of Mexico. They spawn in southwest Florida. Occurrence, distribution and movements of postlarvae and juveniles are discussed. Spawning apparently takes place off of ocean beaches. Postlarvae move into Everglades estuaries at night on incoming tides. One-year-olds (300 mm SL) are fully recruited into the Park fishery. Very large adults leave the estuary and live offshore. Red drum are euryhaline with broad temperature range tolerance. For south Florida, food is mostly crustaceans, especially crabs; shrimp are important in summer. Parasites from south Florida are reported.

Study Period:September 1960-January 1962; Study Type:Qualitative; Habitat:Estuarine/coastal marine; Gear Type:Trawls, dockside interviews, nets; Biological Component:Sportfish; Number of Stations:variable, dockside interviews (Flamingo); Abiotic Parameters Measured:Salinity, water temperature and depth, currents; Dominant Taxon/Taxa Studied:Red drum (*Sciaenops ocellata*, now *ocellatus*).

465. Yokel, B. J. 1970. The relationship of the pink shrimp emigrating from the Everglades National Park to commercial catches on the Tortugas Grounds. Proc. Gulf and Caribb. Fish. Inst., 22:65 (Abs.).

Narrative same as in reference no. 466.

466. Yokel, B. J., E. S. Iversen and C. P. Idyll. 1969. Prediction of the success of commercial shrimp fishing on the Tortugas grounds based on enumeration of emigrants from the Everglades National Park estuary. FAO Fish. Rept. 3(57):1027-1089.

Studies have been underway since 1962 on the juvenile stages of the pink shrimp (*Penaeus duorarum*) in the ENP estuaries. The objectives of this study have been to increase knowledge of the biology and migration of the shrimp and to determine if a relationship exists between the relative abundance of emigrating juveniles and the catches of adults on the Tortugas grounds.Net catches of juveniles from the Buttonwood Canal at Flamingo made near the times of the new and full moon are used as indices of monthly abundance. These show a positive correlation with the commercial landings of the smallest size shrimp. During periods of high abundance, when the mean size of the emigrants is small, there is a delay of 2 to 2.5 months from the time they leave the estuary until they appear in the commercial catches. When the emigrants are larger, the time delay is reduced by one month. Differences in migration times are caused by a delay in the arrival of the shrimp at a size large enough for the trawls to capture. An appropriate time lag improves the correlation between emigrants and CPUE of small shrimp on the Tortugas fishing grounds.

Study Period:January 1963-July 1965; Study Type:Quantitative; Habitat:Canal, open water; Gear Types:Channel and wing nets, trawls; Biological Component:Decapod crustacean (Penaeid shrimp); Number of Stations:Estuarine (1); offshore (variable); Temporal Frequency:Monthly; Abiotic Parameters Measured:Salinity, water temperature and depth, air temperature, wind direction and velocity, water velocity and cloud cover; Dominant Taxon/Taxa Studied:*Penaeus duorarum*.

467. Yokel, B. J., M. A. Roessler and E. S. Iversen. 1967. Fishes and juvenile stages of pink shrimp (*Penaeus duorarum*) collected in Buttonwood Canal, Florida, December 1962 to June 1965. Data Rep. U.S. Fish Wild. Serv. No. 22. 58 pp.

No abstract available.

468. Zieman, J. C. 1976. The ecological effects of physical damage from motorboats. Aqut. Bot. 2:127-139.

A report on the ecological effects of motorboat damage in Florida Bay (ENP) revealed that beds of turtle grass, *Thalassia testudinum*, although highly productive, do not recover rapidly following physical disturbance of the rhizome system. In shallow waters, the most common form of rhizome disturbance was determined to be from the propellers of motorboats. In *Thalassia* beds which were otherwise thriving, tracks resulting from propellers were observed to persist from two to five years. The proportion of fine sediment components was reduced in the

sediments from the boat tracks, and the pH and Eh were also reduced in comparison to the surrounding grassbed. Damage of this type was also reported to occur most often in shallow passes between islands and keys and were found to be the slowest to recover due to the rapid tidal currents.

Study Period:1 month; Study Type:Qualitative; Habitat:Grassbed banks, passes; Biological Component:Benthic flora; Gear Type:Aerial photography, corer, inverted bottle; Number of Stations:8; Number of Replicates/Station:1; Temporal Frequency:Once; Abiotic Parameters Measured:pH, Eh; Dominant Taxon/Taxa Studied:*Thalassia testudinum*.

469. Zieman, J. C. 1982. The ecology of the seagrasses of south Florida: a community profile. U.S. Fish. Wildl. Serv. Biol. Serv. Prog. FWS/OBS-82/25. 158 pp.

This report provides a detailed description of the community structure and ecosystem process of the seagrass ecosystems of south Florida including Florida Bay (ENP), one of the two major areas of seagrass distribution in Florida. This description is based upon a compilation of information from numerous published and unpublished sources. The material covered includes distribution, systematics, physiology, and growth of the plants, as well as succession and community development. The role of seagrass ecosystems in providing both food and shelter for juveniles as well as foraging grounds for larger organisms is treated in detail. Emphasis is given to the functional role of seagrass communities in the overall coastal marine system. The final section considers the impacts of human development on seagrass ecosystems and their value to both man and the natural system. Because seagrass systems are fully submerged and less visibly obvious, recognition of their value as a natural resource has been slower than that of the emergent coastal communities. They must, however be treated as a valuable natural resource and preserved from further degradation.

Study Type:Biological review.

470. Zieman, J. C. and J. W. Fourqurean. 1985. The distribution and abundance of benthic vegetation in Florida Bay, Everglades National Park. Final Rept. for Contract CX5280-2-2204 to Univ. of Va. from Everglades N.P., South Florida Research Center, Homestead, Fla. 105 pp.

This study was undertaken to delineate and describe the benthic vegetation communities in the submerged portions of Florida Bay (ENP). Distributional, standing crop, productivity and isotope data along with water characteristics and sediment properties were used to identify seven primary benthic vegetational communities in Florida Bay: Northeast, East Central, Interior, Atlantic, Gulf, Mainland, and Conchie Channel.Some of these communities were qualitatively compared to communities described in earlier studies (Turney & Perkins 1972, no. 439 in bibliography; Schmidt 1979, no. 348). The importance of environmental factors (salinity, temperature, and light) on controlling the distribution and extent of these communities in Florida Bay was discussed. This report also provides complete data sets for qualitative descriptions of each study site, quantitative standing crop data, leaf mark and C-14 uptake productivity data.

Study Period:1983-85; Study Type:Qualitative, quantitative; Habitat:Open water bays, basins, mudbanks, channels; Gear Type:Underwater visual censusing techniques, aerial photography for benthic community identification/verification, Quadrats (10x10 cm, 10x20 cm, 50x50 cm for standing crop/leaf production, plexiglass cylinders (C-14 uptake); Number of Stations:108 (macrophyte standing crop), 16 (leaf production), 12 (C-14 uptake); Number of Replicates/Station:3 (Standing crop), 16 (leaf production); Temporal Frequency:Seasonally; Abiotic Parameters Measured:Salinity, sediment and water depth, solar radiation; Dominant Taxon/Taxa Studied:*Thalassia, Halodule, Syringodium, Penicillus.*

471. Zieman, J. C., J. W. Fourqurean and R. L. Iverson. 1989. Distribution, abundance, and productivity of seagrasses and macroalgae in Florida Bay. Bull. Mar. Sci. 44:292-311.

In this study the distribution, abundance, and productivity of submerged macrophytes were measured in Florida Bay (ENP) to determine the total productivity and seagrass habitat distribution throughout the region. *Thalassia testudinum* was widely distributed and was the dominant macrophyte species in the 1,660 $km^2$ of seagrass beds contained in the bay. *Halodule wrightii* was also common, but had standing crop significantly less than *Thalassia* at all sample stations. *Syringodium filiforme* grew mainly in areas with strong oceanic influence, especially along the south and west margins of the bay. Macroalgae were a small percentage of the total macrophyte biomass. Gradients in environmental and biological variables extended from southwest to northeast Florida Bay. Water clarity, water exchange, and sediment depth were all greatest in the south and west portion of the bay and decreased towards the northeast corner of the bay. Variations in values and patterns of areal seagrass standing crop and areal leaf productivity are presented. Distribution, abundance, and productivity data were used to divide the bay into six community types. Changes in Florida Bay macrophyte communities are discussed.

Study Period:1979,1983-84; Study Type:Quantitative, qualitative; Biological Component:seagrasses, macroalgae; Gear Types: Aerial photography, visual censusing techniques (benthic community identification), Quadrats (10x10 cm, 10x20 cm, 50x50 cm (standing crop & leaf production), plexiglass cylinders (algal & seagrass C-14 uptake), nets (drift material); Number of Stations:108 (macrophyte standing crop), 16 (leaf production), 12 (algal & seagrass uptake), 42 (drift material sampling); Number of Replicates/Station:3 (standing crop), 16 (leaf production); Temporal Frequency:Seasonal samples; Habitats:Basins, banks, channels; Abiotic Parameters Measured:Sediment depth, water depth; Dominant Taxon/Taxa Studied:*Thalassia, Halodule, Syringodium, Laurencia spp., Penicillus.*

472. Zieman, J. C. and R. T. Zieman. 1989. The ecology of the seagrass meadows of the west coast of Florida. U.S. Fish. Wild. Ser., Washington D.C., Biolo. Rept. 85(7.25). 155 pp.

This report summarizes information on the ecology of seagrass meadows on the west coast of Florida, from south of Tampa Bay, including the Ten Thousand Islands and Whitewater Bay area of ENP, to Pensacola. Overall, this region contains more than 3,500 ha of seagrass beds, dominated by three species, *Thalassia testudinum* (turtle grass), *Syringodium filiforme* (Manatee grass), and

*Halodule wrightii* (shoal grass). Beds occur both on the shallow, zero-energy Continental Shelf and in the inshore bays and estuaries. Species ecology, distribution, biomass, and productivity of these dominant seagrass species are discussed. Seagrass beds support a very diverse and abundant algal flora and fauna, and these organisms and seagrass detritus form the base of a productive food chain. Seagrass beds are important nursery areas providing both cover and food, for a number of commercial and sports fishery species. Along the west coast of Florida, estuarine grass beds are noticeably more stressed and impacted by human activities than the more pristine nearshore beds. Urban development and dredging and filling are the major threats to seagrass beds in this region.

Study Type:Biological review; Biological Component:Flora & fauna.

473. Zug, D. A. and W. A. Dunson. 1979. Salinity preference in fresh water and estuarine snakes (*Neridia sipedon* and *N. fasciata*). Fla. Sci. 42:1-8.

Salinity preference in aquatic snakes was measured in a divided aquarium over a 6 hr period. Comparative studies were made on 5 species of snakes from marine, estuarine, and fresh water habitats. *N. fasciata compressicauda*, collected from Collier County waters, within and/or adjacent to ENP, showed preference for fresh water during most laboratory tests.

Study Type:Quantitative, qualitative; Habitat:Coastal mangrove (ENP); Biological Component:Marine/estuarine snakes; Dominant Taxon/Taxa Studied:*Nerodia f. compressicauda*.

## ADDENDUM[1]

500. Bosence, D. 1989. Carbonate budgets for carbonate mounds Florida, USA. Coral Reef Symposium, 6th, Townsville, Australia, Proceedings. Vol. 2, P. 529-534.

Carbonate production rates are compared with sediment volumes for shallow water mounds in Florida Bay (ENP) along a transect from the back-reef Tavernier mound to Buchanan Bank in outer Florida Bay to Upper Cross Bank, inner Florida Bay. Production rates are established from standing crop and growth rate data. Production rates decrease by orders of magnitude from reef to back-reef and outer-bay mounds and from outer to inner-bay mounds. Intermound production is less than mound production but represents 90% of the inner-bay area and therefore contributes more sediment to the region than the mounds. It was found that the inner-bay has IMPORT MOUNDS, the outer-bay has EXPORT MOUNDS and that probably there is large-scale sediment transport out of the bay to account for overproduction of biogenic carbonate since it was flooded some 3700 years ago.

Study Period:1985; Study Type:Quantitative; Gear Type:Cores, probes, quadrats; Biological Component:Flora & fauna.

501. Bosence, D. and D. Waltham. 1990. Computer modeling the internal architecture of carbonate platforms. Geology 18:26-30.

A numerical computer model is described that calculates the internal architecture of carbonate platforms in response to varying values of carbonate production, subaerial and submarine erosion, sediment redeposition, and sea-level changes. The computer-generated sections closely resemble large-scale outcrops and interpreted seismic profiles through carbonate platforms. Stillstand and transgressive sequences have prograding and downlapping platform geometries with lagoons developing in transgressive systems. Regressive sequences have downlapping clinoforms and erosional upper surfaces. Carbonate erosion rates are varied and have an important effect on the morphology of floodback surfaces. Data for lagoonal and back-reef production rates are taken from Bosence (1989, no. 500 in addendum). The computer program gives a visual picture of the quantitative effects of the many parameters controlling carbonate geometrices, and it aids quantitative analysis of the architectures and time scales of ancient outcrop or seismic sequences.

Study Type:Model

502. Chester, A. J. and G. W. Thayer. 1990. Distribution of spotted seatrout (*Cynoscion nebulous*) and gray snapper (*Lutjanus griesus*) juveniles in seagrass habitats of western Florida Bay. Bull. Mar. Sci. 46(2):345-357.

The distribution, abundance, and biomass of juvenile spotted seatrout (*Cynoscion nebulous*) and gray snapper (*Lutjanus griesus*) were evaluated along with

[1]These citations, located after the major part of the bibliography was completed, are also included in the indexes.

information on seagrasses, sediments, water temperature and salinity in basin and channel habitats of western and central Florida Bay (ENP) during 1984-1985 (see Thayer et al. 1987, no. 425 in bibliography). Spotted seatrout juveniles were most prevalent in basin habitats in the western portion of the bay and were collected during every month sampled except May (1984); smallest individuals were collected were collected during May (1985), June (1984, 1985), and July (1984). The habitats in which spotted seatrout occurred had deeper, more organic sediments with greater density and biomass of the seagrass, *Syringodium filiforme*, than did non-seatrout areas. Gray snapper juveniles were most prominent in channels of the southeastern part of the bay. The presence or absence of gray snapper was related to the distribution of seagrass biomass, particularly that of *Thalassia testudinum* and *Syringodium*. These data suggest that seagrass meadows are critical habitats for spotted seatrout and gray snapper in Florida Bay.

Study Period:1984-1985; Study Type:Qualitative, quantitative; Habitat:Open water seagrass basins and channels; Gear Type:Bottom/surface trawls; Number of Stations:18 during each of nine surveys (Fish, vegetation, sediment); Number of Replicates/Station:1 (Fish), 3 (vegetation), 1 (sediment); Biological Component:Sportfish, seagrass; Abiotic Parameters Measured:Salinity, temperature, sediment characteristics; Dominant Taxon/Taxa Studied:*Cynoscion nebulous*, *Lutjanus griesus*.

503. Childers, D. L., J. Fourqurean and G. V. N. Powell. 1989. Intertidal seagrass banks as critical estuarine habitat: Evidence from a nutrient exchange study in Florida Bay, FL. Abstracts 10th Biennial Estuarine Research Conf., Baltimore, MD p. 15.

The transformation and intertidal exchange of nutrients and materials by intertidal seagrass banks represents an indirect habitat interaction with the associated estuarine water column. These processes were measured on a regularly-exposed *Halodule/ Thalassia* bank in western Florida Bay (ENP) over 5 tidal cycles using a 60 m through-low flume. Averages of significant fluxes are provided and compared with exchanges from flumes in Louisiana marsh systems. Fluxes from the Florida Bay seagrass bank were orders of magnitude greater --1 for inorganic nitrogen, 1-2 for POC and PON, and 3 for TSS.-Adapted from authors' abstract.

504. Crane, J. L. and C. A. Shearer. 1986. *Nais Glita*, an Ascomycete from red mangrove in Everglades National Park, Florida. Trans. Br. mycol. Soc. 86(3):509-512.

In this note *Nais glitra* sp.nov., on submerged wood of red mangrove, Coot Bay (ENP), is described.

Study Type:Qualitative; Habitat:Estuarine.

505. Durako, M. J. 1989. Morphoanatomical characteristics and recovery potential of *Thalassia testudinum* in sites affected by die-back in Florida Bay. Abstracts 10th Biennial Estuarine Research Conf., Baltimore, MD. p. 22.

Morphoanatomical analyses of *Thalassia* ramets collected from 3 basins affected by die-back in Florida Bay (ENP) revealed significant temporal and spatial variability. Short-shoot and rhizome apex densities, maximum leaf lengths and widths, shoot-specific and bottom-specific leaf areas significantly decreased along a gradient from healthy beds to die-back patches. Mean numbers of leaf scars and leaves per short-shoot significantly increased along this same gradient during summer; surviving short-shoots within die-back patches were characteristically solitary. However in November, the mean leaf scar pattern was reversed. Ten percent of the short-shoots collected had new rhizome apices, and up to 40% of the short-shoots in die-back and dying fringe samples exhibited a novel branching pattern.-Adapted from author's abstract.

506. Ehrhardt, N. M. 1990. Mortality and catchability estimates for the stone crab (*Menippe mercenaria*) in Everglades National Park. Bull. Mar. Sci. 46(2):324-334.

Estimates of natural mortality have not been reported for the stone crab, *Menippe mercenaria*, yet this information is essential for describing its population dynamics and to manage the stocks. In this study, mortality of adult males inhabitating an area off Cape Sable (ENP), was estimated by sequential tagging experiments and by analysis of fishery statistics. Natural mortality rates range from 0.780 to 6.867 per annum. Differences in rates are attributed to dominance of specific size groups. The higher rates corresponded with individuals with carapace widths at or above the average size at terminal molt. Difficulties in aging crustaceans are considered. The true age composition of the stocks may never be known from standard commercial statistics since only the claws are harvested and landed.

Study Period:1984-1985; Study Type:Qualitative, quantitative; Gear Type:Traps, tagging; Number of Stations:385 traps fished in a 10 $km^2$ area; Temporal Frequency:Bi-weekly; Biological Component:Decapod crustacean; Dominant Taxon/Taxa Studied:*Menippe mercenaria*.

507. Ehrhardt, N. M., D. J. Die and V. R. Restrepo. 1990. Abundance and impact of fishing on a stone crab (*Menippe mercenaria*) population in Everglades National Park, Florida. Bull. Mar. Sci. 46(2):311-323.

The stone crab (*Menippe mercenaria*) supports an important commercial fishery in SW Florida. Heavy commercial exploitation of stone crab stocks in ENP, prompted statements of concern about their status of utilization. During the 1983 and 1984 fishing seasons, tagging studies, diving surveys, and monitoring of commercial fishing operations were implemented to assess abundance and rate of exploitation of localized stocks. Results indicate that an important stock is centered off Cape Sable, an adult male stock recruited in the spring and summer of 1984 was almost fully utilized during the first 5 months of the season, and fishing mortality associated with the 1984 fishing season was 0.751 while expected natural mortality rate for the same period was 0.939. It was concluded that the fishing season may protect berried females during peak summer spawning as well as acting as a buffer against fishing exploitation. Under new regulations all commercial fishing activities in ENP ceased as of 31 December 1985, thus the need to study population growth under conditions of no exploitation was indicated.

Study Period:1983-1985; Study Type:Quantitative; Gear Type:SCUBA, wire cable (transects), bottom area estimates, tagging; Number of Stations:42 (dive sites), Number of Replicates/Station:2 areas at each dive site; Biological Component:Decapod crustaceans; Dominant Taxon/Taxa Studied:*Menippe mercenaria*.

508. Galli, G. 1989. Is Holocene storm-generated stratification in Florida Bay a reflection of solar storm cycles? Palaeogeography, Palaeoclimatology, Palaeoecology 76:169-185.

A descriptive analysis of surficial sediments of Crane Key (Florida Bay/ENP) showed that the sediments consist of storm layers (winter storm and hurricane deposits) and algal laminated sediments. Storm layers were riddled with gas escape vugs; dissolution vugs; burrows; rootholes and cryptal vugs. Structures and sediment types were arranged into a 15 cm thick sequence which formed approximately 100 yr under a deepening trend. Sea level variations match the frequency distribution of strong intensity storms which occurred in south Florida since the beginning of the century. The recurrence time of strong storms and the time interval of formation of the sequence were a response of climatic parameters to short-period and longer-period cycles of solar activity. Comparison with the ancient record shows analogous dm-thick storm-generated sequences probably linked to solar cycles and 10 2-yr sea-level rises.

Study Type:Quantitative; Gear Type:Box cores; Number of Stations:4 core locations; Abiotic Parameters Measured:Sediment characteristics.

509. Harriss, R. C., D. I. Sebacher, K.B. Bartlett, D. S. Bartlett, and P. M. Crill. 1988. Sources of atmospheric methane in the south Florida environment. Am. Geophys. Union:Global biogeochemical cycles, Vol. 2, No. 3. Pgs. 231-243.

This paper reports the results of methane ($CH_4$) flux studies conducted over a 5-year (1980-1985) period in south Florida, with emphasis on ecosystems in ENP. Studies focused on $CH_4$ flux from four categories of wetland ecosystems: 1) wet prarie and sawgrass marsh, 2) wetland forest, (3) high-salinity mangrove swamp, and (4) man-made impoundments and disturbed wetlands. In the coastal mangrove swamp near Flamingo, soil temperature, water depth, and $CH_4$ flux were measured at several sites between 1982-85. Results indicated that freshwater wet praries and sawgrass marsh are the dominant sources of atmospheric methane in the region. In addition, it was found that the integrated effects of urban and agricultural development in south Florida between 1900 and 1973 resulted in a 26% enhancement in methane flux to the troposphere.

Study Period:1980-1985; Study Type:Quantitative, qualitative; Habitat:Variable; Number of Stations:Variable, in coastal mangrove-3+; Temporal Frequency: Irregular; Abiotic Parameters Measured:Soil temperature, water depth, $CH_4$ flux.

510. Kinch, J. C. and W. Lam E. O'Harra. 1976. Characteristics of the sport fishery in the Ten Thousand Islands area of Florida. Bull. Mar. Sci. 26:479-487.

This study represents the first in-depth analysis of the sport-fishing catch and effort in the upper Ten Thousand Islands area. It was undertaken to provide comparative observations with similar studies along the southern coastal areas of ENP and to provide a basis for future comparasions of fishing pressure upon these resources as the area's human population grows. Seasonality was found to be the major factor in fishing pressure. The charter-guide method was the most successful in catch per unit effort.

Study Period:Aug 1971-Jun 1974; Study Type:Qualitative, quantitative; Gear Type:Dock-side interviews, aerial boat counts; Number of Stations:Five fishing areas-3 in ENP; Temporal Frequency:Interviews-10/12 random days/month, boat counts-7 days/month; Dominant Taxon/Taxa Studied:Spotted seatrout *Cynoscion nebulosus*, gray snapper *Lutjanus griesus*, red drum *Sciaenops ocellatus*, snook *Centropomus undecimalis*.

511. Lyons, W. G., D. G. Barber, S. M. Foster, F. S. Kennedy Jr. and G. R. Milano. 1981. The spiny lobster, *Panulirus argus*, in the Middle and Upper Florida Keys: Population structure, seasonal dynamics, and reproduction. Fla. Mar. Res. Rept. No. 38. 45 pp.

Data on abundance, distribution, size, sex, mating, spawning, molting, incidence of fouling organisms, and injury rates were obtained from 19,180 lobsters at nine stations in the upper and middle Keys fishery area during April 1978 through March 1979. Mean and modal carapace (CL) sizes were approximately 73 mm, slightly below legal size (76 mm). Lobster sizes at shallow Florida Bay stations averaged 65 mm CL. Distribution of lobsters was age- and habitat-related. Of the 3 inshore bay sites sampled, 2 were located within and/or adjacent to the extreme southeastern/western boundary of ENP in Florida Bay. Legal-sized lobsters on the bay side constituted 44% of the catch. Mean total number of lobsters per trap per week was 0.84, constituting 0.70 at bay stations and 0.91 oceanside. No mating occurred among bayside lobsters. Fouling by sessile invertebrates was slight or absent on most lobsters while frequency of molting was higher at inshore sites. Unexplainably low previous-injury rate of sublegal-sized lobsters during the open season suggests they may have experienced considerable mortality due to fishery practices.

Study Period:April 1978-March 1979; Study Type:Qualitative, quantitative; Gear Type:Traps; Number of Stations:9 (6 oceanside, 3 bayside); Habitat:Seagrass beds in ENP area; Biological Component:Decapod crustacean: Abiotic Parameters Measured:Water temperature; Dominant Taxon/Taxa Studied:*Panulirus argus*.

512. Parkinson, R. W. 1989. Decelerating Holocene sea-level rise and its influence on southwest Florida coastal evolution: A transgressive/regressive stratigraphy. J. of Sed. Petro. 59(6):960-972.

The Ten Thousand Islands (TTI), a myriad of low-relief mangrove islands mostly within the western portion of ENP, is one of the few areas in North America where open marine, low wave energy coastal sedimentation can be observed. The region has been subjected to a relative rise in Holocene sea level, which has continuously decelerated to its present rate. It was found that the Holocene sediment package of the TTI area consists of two sediment sequences. The lower sequence is

transgressive; it was submerged and replaced by a shallow coastal marine setting. The upper sediment sequence consists primarily of 1) biogenic shallowing upwards sequences or 2) thickened mangrove peat layers. Island emergence further reduced wave and current energy and promoted the infilling of the protected bays. The formation of this transgressive/regressive sequence is related to changing rates of Holocene sea-level rise, reported to have occurred between 3,500 and 3,200 YBP. Continued regressive sedimentation could eventually generate a 5-10 m thick transgressive/regressive sediment couplet, with an aerial extent of over 300 $km^2$, in 10,000 years. The results of this study clearly suggest that the rate of sea-level rise is a viable working hypothesis, as it can be seen to operate within a modern coastal system.

Study Type:Quantitative; Gear Type:Vibracores; Number of Stations:45 vibracores; Abiotic Parameters Measured:Sediment types, grain size and thickness.

513. Porter, D. and L. K. Muehlstein. 1989. The role of fungi and slime molds in the die-back of *Thalassia testudinum* in Florida Bay. Abstracts 10th Biennial Estuarine Research Conf., Baltimore, MD. p. 65.

The wide spread die-back of turtle grass, *Thalassia testudinum*, in Florida Bay (ENP) is characterized by once continuous meadows of turtle grass which have either been completely lost or are interspersed at frequent intervals by irregular patches of bare sediment. The live plants near the die-back areas have many blackened streaks and spots on their leaves. These necrotic regions are symptoms of a disease which may be a direct cause of the disease. It was found that an undescribed species of the marine slime mold, genus *Labyrinthula*, is the only eukaryotic microorganism associated with the necrotic leaf pieces at a much higher frequency than from green leaf pieces. The relationship between seagrass disease and *Labyrinthula* is not unexpected. A different species of *Labyrinthula* has been demonstrated to be the cause of the wasting disease of eelgrass, *Zostera marina*.-Adapted from authors' abstract.

514. Robblee, M. B. 1989. Changes in benthic fauna associated with an extensive seagrass die-off in western Florida Bay. Abstracts 10th Biennial Estuarine Research Conf., Baltimore, MD. p. 69.

Seagrasses, principally *Thalassia testudinum*, have experienced extensive die-off in western Florida Bay (ENP) since the summer of 1987. Die-off has resulted in areas of complete canopy loss ranging from several square meters to hundreds of hectares. In a few instances, *Halodule wrightii* has replaced turtle grass as the dominant seagrass after die-off. Currently, stations sampled quantitatively for pink shrimp, careidean shrimp, and benthic fish prior to seagrass die-off are being resampled to evaluate impacts on shrimp and fish abundance and species composition as well as differences in shrimp and fish relationships to grass canopy structure. Western Florida Bay, a major nursery ground is possibly the principal nursery ground for the Tortugas pink shrimp fishery. It is likely that seagrass die-off on the scale being seen in Florida Bay will seriously impact its nursery function.-Author's abstract.

515. Schropp, S. J., F. G. Lewis, H. L. Windom, J. D. Ryan, F. D. Calder and L. C. Burney. 1990. Interpretation of metal concentrations in estuarine sediments of Florida using Aluminum as a reference element. Estuaries. 13(3):227-235.

Metal contamination of coastal and estuarine sediments, an increasing problem in Florida, results from anthropogenic activities both along estuarine shorelines and in upland watersheds. Interpretation of anthropogenic metal concentrations has been hampered by the fact that natural metal concentrations in sediments vary considerably in different sediments. In this paper an interpretive method is described based on the statistical relationship between sediment metals and aluminum derived from statewide data on natural estuarine sediments in Florida. Clean sediment sampling sites were located in ENP from Chokoloskee Bay in the Big Cypress estuary to Florida Bay. It was shown that this method can be used to interpret metal concentrations with an example using data from the Miami River and Biscayne Bay.

Study Period:1985-1987; Study Type:Qualitative, quantitative; Habitat:Estuarine, coastal marine sediments; Gear Type:Core tubes; Number Of Stations:103, (In ENP-4 estuaries are represented with exact station locations unknown); Number of Replicates/Station:2; Abiotic Parameters Measured:Al, Pb, Zn, Cd, Cr, Ni, Cu, As.

516. Smith, T. J., III, H. T. Chan, C.C. McIvor and M. B. Robblee. 1989. Comparisons of seed predation in tropical, tidal forests from three continents. Ecology. 70(1):146-151.

An inverse relationship between the amount of seed predation and the dominance of a tree species in mangrove forest canopies has been hypothesized by the senior author. Seed predation experiments have been performed in mangrove forests of North America (Florida/ENP and Panama) and SE Asia (Malaysia) on species of *Avicennia*, *Bruguiera*, and *Rhizophora*. Within the coastal mangrove zone of ENP, four intertidal forests were studied: a *Rhizophora* dominated forest at Flamingo; an *Avicennia* dominated forest at Snake Bight; and, a *Rhizophora* and a *Avicennia* dominated forest at Coot Bay Pond. Significant differences were found in the amount of predation on *Avicennia*. All *Avicennia* were consumed in greatest quantity where they were rarest in the forest canopy and in least amounts where they dominated the canopy. Results were similar for *Rhizophora*, except in ENP where no *Rhizophora* were eaten. Data for *Avicennia* support the dominance-predation model. In Florida (ENP), three species of snails are the most important consumers of propagules.

Study Period:1986-1987 (In ENP, Jul-Aug 1986); Study Type:Quantitative; Habitat:Coastal Mangrove; Number of Stations:10 (4 in ENP); Number of Replicates/Station:Variable; Biological Component:Mangroves, crabs, snails; Dominant Taxon/Taxa Studied:*Rhizophora*, *Avicennia*.

517. Textoris, S. D. 1988. Stratigraphy and depositional history of Late Pleistocene Key Largo patch reefs underlying Florida Bay. M.S. Thesis, Wichita State Univ., Wichita, Kans. 165 pp.

This study, conducted in Florida Bay (ENP) utilizing twenty cores of Pleistocene bedrock which were taken up to 70 ft. in depth, and based on a classification scheme developed by R.D. Perkins 1977 (no. 294 in bibliography), identified four marine-deposited units (Q1 through Q4) in Upper Pleistocene rocks underlying the Bay. Differentiation between units was based upon unconformities and subaerial features associated with sea level lowstands. Antecedant topography affected Pleistocene sedimentation. The Pleistocene shelf-edge and an open-marine platform were among the major factors influencing sedimentation in South Florida and Florida Bay during Q1 time. Sea level transgression during Q2 time resulted in a transition from clastic sedimentation to in situ carbonate production and deposition. In Q3 time a barrier reef grew on the Pleistocene shell-edge. A lagoonal back-reef area (Florida Bay) developed leeward of the barrier. Fluctuations in sea level greatly affected facies deposition and patch-reef growth during Q3 and Q4 time. East Key patch-reef initiated growth from a Q3 mound subsequent to a minor sea level drop; subaerial exposure of the reef at the end of Q3 time resulted in death of the reef.

Study Period:Summer 1985, 1988; Study Type:Quantitative, qualitative; Number of Stations:20 core locations; Biological Component:Flora & fauna; Abiotic Parameters Measured:Sediment characteristics.

518. Thompson, M. J. and M. B. Robblee. 1989. Remote monitoring of seagrass die off in Florida Bay, Everglades National Park, Florida. Abstracts 10th Biennial Estuarine Research Conf., Baltimore, MD. p. 82.

Extensive dying of seagrasses within climax *Thalassia testudinum* seagrass beds was first reported from Florida Bay (ENP), in the fall of 1987. Dying of seagrass beds in that area has continued and the phenomena appears to be spreading beyond the confines of Florida Bay. Aerial imagery from 1972, 1987, and 1989, and SPOT satellite imagery from 1987 through 1989 has been used to map the extent and the rate of spread of seagrass destruction. Remotely monitored signatures indicative of die-off are identified and possibilities for future, larger scale remote monitoring is discussed.-Authors' abstract.

519. University of Georgia Marine Institute and The Skidaway Institute of Oceanography. 1973. The geological inventory of Cumberland Island, Everglades National Park, Gulf Islands National Seashores, and Biscayne National Monument. Final Report: Contract CX001-3-0052 to NPS, Washington D. C.

This report presents a total of 130 published and unpublished references on the geology and geological processes of the subject areas. A brief, annotated bibliography of approximately 30 pertinent citations on ENP is included. Data gaps and research priorities for future study in the subject areas are discussed.

Study Type:Qualitative, geological review, bibliography.

520. Yarbo, L. A., P. R. Carlson Jr, S. Benford and T. A. Tedesco. 1989. Sediment sulfide and physiological characteristics of *Thalassia testudinum* in die-back areas of Florida Bay. Abstracts 10th Biennial Estuarine Research Conf., Baltimore, MD. p. 92.

Sediment sulfide concentrations, as well as alcohol dehydrogenase activities and amino acid concentrations in *Thalassia testudinum* rhizomes, were measured in die-back patches located in three basins in Florida Bay (ENP). Sediment sulfide concentrations of 1.3 to 7.8 millimolar were congruent with variations in the intensity of die-back among sites. Rhizome ADH activities were significantly correlated with sediment sulfide concentrations. Significant differences were found among basins for concentrations of total free amino acids, glutamic acid, proline, and arginine. Glutamine and proline also exhibited significant differences among die-off zones. Current data suggest 1) hypoxic stress may play an important role in the die-off process and 2) physiological assays may be dramatically affected by tissue heterogeneity.-Adapted from authors' abstract.

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